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Surveying and Mapping

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Quarterly Journal

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The American Congress on Surveying and Mapping is a non-profit association, organized to advance the sciences of surveying and mapping in their several branches, in furtherance of the public welfare and in the interests of both those who use maps and surveys and those who make them. It aims to establish a central source of reference and union for its members, to contribute to public education in the use of surveys and maps, and to encourage the prosecution of basic surveying and mapping programs, especially those programs which are paid for, in whole or in part, with public funds.

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SURVEYING AND MAPPING

A. L. Shalowitz, *Editor-in-Chief*

A Quarterly Journal
Devoted to the Advancement of the Sciences
of Surveying and Mapping

Volume XI, No. 2
April–June 1951

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The Eleventh Annual Meeting

- **Date..... June 18, 19, 20, 1951**
- **Place..... Shoreham Hotel, Washington, D. C.**
- **Theme..... Surveys and Maps—the Basic Blueprints for Peace and Development**

The American Congress on Surveying and Mapping holds a unique responsibility in a field of public welfare in which it stands alone—that of providing a meeting place for both those who use surveys and maps and those who make them. In the past 10 years, the value of surveys and maps, not only from the military angle, but also because of their use in the development of natural resources for civilian needs and the expansion of industrial capacity to meet the growing requirements of our rising standards of living, has been increasingly appreciated.

In planning the agenda for the Eleventh Annual Meeting, your officers, directors, and committees have kept in mind these responsibilities of the Congress and have produced a program which deserves your support. Opportunity will be provided for discussion of the papers presented and you are urged to attend and participate.

Surveys and maps are a universal language and provide a common denominator for the presentation of facts in the discussion of international problems. At the Annual Meeting, the exhibits prepared by the principal United States Government mapping agencies for the Fifth Consultation of the Pan American Institute on Cartography, held at Santiago, Chile, will be displayed. Their titles will be in English and Spanish. This will be the first showing of this exhibit in the United States. Subjects of Inter-American significance will be presented by several speakers from Canada and Latin-American countries.

Formation of a new Technical Division on Education will be one of the highlights of the meeting under the leadership of Russell C. Brinker, Professor of Civil Engineering at Virginia Polytechnic Institute, temporary chairman. One of its objectives will be to broaden and modernize courses in surveying, mapping, and related subjects offered by colleges and universities.

On Monday evening, June 18, each technical division will have its own special program to give its members an opportunity to discuss problems of particular interest to them. During the 3-day meeting, each technical division also will sponsor a program to insure the inclusion of subjects of interest to all members of the Congress.

Social functions will include a cocktail party, a banquet, and a dance. A special program of interest to ladies who are guests of the members of the Congress also is planned.

GERALD FITZGERALD
President

Apr. • May • June • 1951

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A Possible Solution to the Problems of Surveying and Mapping Education

By PROF. GEORGE H. HARDING

DIRECTOR, MAPPING & CHARTING RESEARCH LABORATORY, OHIO STATE UNIVERSITY RESEARCH FOUNDATION

THE PROBLEM of surveying and mapping education is one which has been the subject of much discussion and increasing concern to qualified map and chart makers, surveyors, photogrammetrists, geodesists, and cartographers for the past two decades. This field of endeavor is certainly one of very few, if not the only one, where professional standing is recognized in both governmental agencies and commercial organizations, although no complete course of training in these related fields leading to appropriate degrees has been established in our institutions of higher learning.

The United Nations Board of Experts of which the first President of this Congress, Mr. Robert Randall, is Chairman, has defined "modern cartography" as including all those steps necessary to produce adequate maps and charts, from the original control surveys through the topographic or hydrographic surveys, photogrammetric or other processes, compilation and editing, to the final stage of map and chart reproduction itself. For the sake of brevity I shall use the term modern cartography in this new and all-inclusive sense.

A generally accepted definition of education might be "the acquisition of knowledge." You would all probably agree that the acquirement of this knowledge without the reasoning ability to use it intelligently and for constructive purposes would be a waste of time and effort.

Knowledge in any particular field may be acquired in one of three ways. The first, easiest, and usually considered to be the most thorough is a formal series of courses including lectures, recitations, laboratory practice and experiments, and the inevitable examinations presented in our established educational institutions.

The second, and one common to the early stages of all our professions, might be described as an "educational apprentice system" whereby the seeker after knowledge, by years of diligent effort under the direction of a qualified practitioner, acquires, subject to the individual limitations of both apprentice and practitioner, the skills and knowledge of the practitioner.

Third, and last, is the acquisition of knowledge from the writings of others, with no direct access to those who might be in a position to counsel and explain. There are those here who have acquired their knowledge of the field by one of the last two methods, or a combination of them, but no one educated in this hemisphere has acquired his proficiency in these related fields by the process of formal education alone since complete facilities for this training do not, as yet, exist.

PRESENT EDUCATIONAL FACILITIES

Our problem then, is the presence of an *existing profession* with no complete and adequate formal training for this profession designed to constantly take into

Presented at Tenth Anniversary Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 21–23, 1950.

account new developments and techniques whose practicability has been demonstrated.

What are the reasons for this condition? Perhaps an analysis of them may aid us in aiming at a solution. Traditionally, surveying and mapping have been included in the civil engineering departments of our engineering colleges, although there are instances where surveying and mapping are presented by departments of geology, forestry, architecture, mining engineering, and others. Instruction in geodesy and photogrammetry is meagre, if not nonexistent, in all but a few instances. Current cartographic and compilation processes and map or chart reproduction techniques are not covered in presently offered courses.

To further complicate the problem, the development of electronic computing and measuring equipment goes on apace, adding additional educational requirements for our cartographer of tomorrow.

Shall we say, therefore, that civil engineering is not performing its duty by omitting many courses which modern cartography needs? That is not the case! If the courses which we recognize now are needed by our modern cartographer were added to the civil engineering curricula, other courses would have to be removed from the curricula and the civil engineering requirements as such could not be met.

There has been a simultaneous evolution in which courses needed for the cartographer of tomorrow have multiplied while at the same time logical developments within civil engineering proper have increased the demand for new courses in the structural, highway, sanitary, soils, and hydrological divisions. To meet these latter demands and at the same time meet the requirements for both basic and broadening courses, surveying and mapping courses in many institutions have been, and are still being, reduced in number and hours.

When you consider the points involved, this attrition of surveying and mapping courses—this evolutionary process—seems both logical and desirable, from the standpoint of modern cartography as well as civil engineering.

The courses which are needed for the modern cartographer are for the most part not civil engineering as such. Additional mathematics, geology, electronics, physics and optics, astronomy, geography, and meteorology are needed either as prerequisites or to supplement sound and rigorous courses in geodesy, photogrammetry, cartography, and the graphic arts essential to map and chart reproduction.

On the other hand the modern cartographer will have no particular need for courses essential to the civil engineering curricula such as water supply, steel and concrete design, sanitary and highway design.

So apparently the modern cartographer, having come of age so to speak, must leave the "old homestead" of civil engineering and establish his own home if he is to achieve his destiny. If this be the case where and how can this be done?

A PILOT PLANT IS NEEDED

With most new chemical and manufacturing processes a "pilot plant" is established. Through careful study, both the process and the product are examined, compared, and improved upon until it becomes economically feasible to change over other plants to meet the demand for the new product. So it must be in producing the cartographers of tomorrow; a "pilot plant" must be established.

This pilot plant must bring together outstanding authorities as teachers in

the modern cartographic fields which we have mentioned and, due to the rapid changes taking place in these fields, must have as a vital component an active and flourishing research effort and organization with which the instructional group are familiar, and in which they should participate if only to a limited extent.

It is to be hoped that the products of the pilot plant will completely justify the effort made and that their training as modern cartographers will be facilitated by *constructive* criticism and suggestions from potential users of the product both during and after the initial training process.

I am not advocating that several hundred colleges start attempting to train modern cartographers this year or next. At the moment this would be disastrous. At this time sufficient highly qualified staff instructors in all these related fields are just not available. I am hopeful that this pilot plant for the production of modern cartographers will be put into operation at some educational institution which is farsighted enough to see the ultimate need, as well as to initially discharge the educational responsibility, for this new profession already in existence.

Present factors of *relatively* limited demand for the product, high cost of up-to-date equipment, scarcity of highly qualified instructional staff material, and the necessity for an active effective research component will immediately limit the number of institutions capable of efficiently operating a complete pilot plant. Negotiations currently under way indicate a good possibility that the pilot plant will start functioning in the fall of this year.

In 1939 and 1940, and early 1941, I was confident of the need for, and the ultimate success of, an organization to be devoted entirely to the related fields of surveying and mapping. Some of you here today I convinced then of that need in spite of what you believed to be your better judgment; today we are in attendance at the Tenth Anniversay Meeting of that organization. We have gone far, but we still have much further to go. I am just as confident today that, as the next logical step in the development of our profession, formal courses covering the entire field of modern cartography in at least one or more of our institutions of higher learning will be established, will succeed, and will begin a new era for the Cartographer of Tomorrow.

❦ ❦ ❦

Yale Establishes Map Unit

THE GREATLY INCREASED use of maps in classroom teaching has led to the establishment at Yale University of a Cartography Laboratory, one of the few of its kind in any American educational institution.

Announcement of this new undertaking and of the appointment of Robert L. Williams as Cartographer and Research Assistant in Cartography was made jointly by Edgar S. Furniss, Provost, and Alexander O. Vietor, Curator of Maps at the Yale Library.

The Cartography Laboratory, set up in the Yale Library, has been established to compile and prepare maps, charts, graphs, and diagrams for use by the faculty and departments of the University. Mr. Williams and his three student assistants will prepare individual and groups of maps for various courses, lectures, forums, conferences, and displays. In addition, they will prepare maps to illustrate books and articles by Yale faculty members.—*New York Times*, October 29, 1950.

Public-Land Lines on Topographic Maps

By LLOYD E. MARSDEN
TOPOGRAPHIC ENGINEER, U. S. GEOLOGICAL SURVEY

IT HAS LONG BEEN the practice of the U. S. Geological Survey to show on its topographic maps the network of land lines established by the General Land Office (now officially known as the Bureau of Land Management). Lines shown on topographic maps represent lines originally established or officially reestablished in relation to the terrain and cultural developments, insofar as they can be determined by a diligent search in the field and by an adjustment of the land lines as shown on official land plats.

The territories from which the so-called public-land states have been formed consisted of land turned over to the Federal Government by the Colonial States or acquired by purchase from, or treaty with, the native Indians and foreign governments. The largest of these purchases was the Louisiana Territory, acquired from France in 1803. It comprised what are now the States of Louisiana, Arkansas, Missouri, Iowa, Nebraska, South Dakota, North Dakota, Montana, and most of Oklahoma, Kansas, Wyoming, Minnesota, and more than one-third of Colorado. Much of the southwestern United States was ceded by Mexico in 1848. The Northwest Territory, which included the States of Oregon, Washington, Idaho, and a corner of Wyoming, was acquired from Great Britain by treaty in 1846. Florida was bought from Spain in 1819. With the exception of Texas and the Gadsden Purchase in 1853, covering southern Arizona and New Mexico, the remainder of public lands was acquired by treaty from our native Indians. Texas was an independent republic for 10 years prior to its admission as a state in 1845. Public-land surveys have been extended or are now being continued within the Territory of Alaska and the 29 states that have constituted the public domain. Public-land surveys have not been executed in the lands retained by the Thirteen Original Colonies, nor in the States of Texas, Tennessee, Kentucky, West Virginia, and parts of Ohio.

RECTANGULAR SYSTEM

The rectangular system for surveying public lands of the United States was initiated by the Continental Congress in 1785. In general, this provided for lines to be run north and south and east and west at right angles so that the land could be divided into 1-mile squares, each containing approximately 640 acres.

In order to carry out the above requirements, the following procedure was initiated:

1. The establishment of independent initial points, each to serve as an origin for surveys to be extended in that locality.
2. The running of principal meridians, from which the range lines were numbered east and west, and the running of base lines at right angles to the principal meridians, from which the townships were numbered north and south.
3. The establishment of guide meridians, initiated at base lines, and of standard parallels, starting at principal meridians, at intervals sufficiently near each other to keep the township unit within the legal size.

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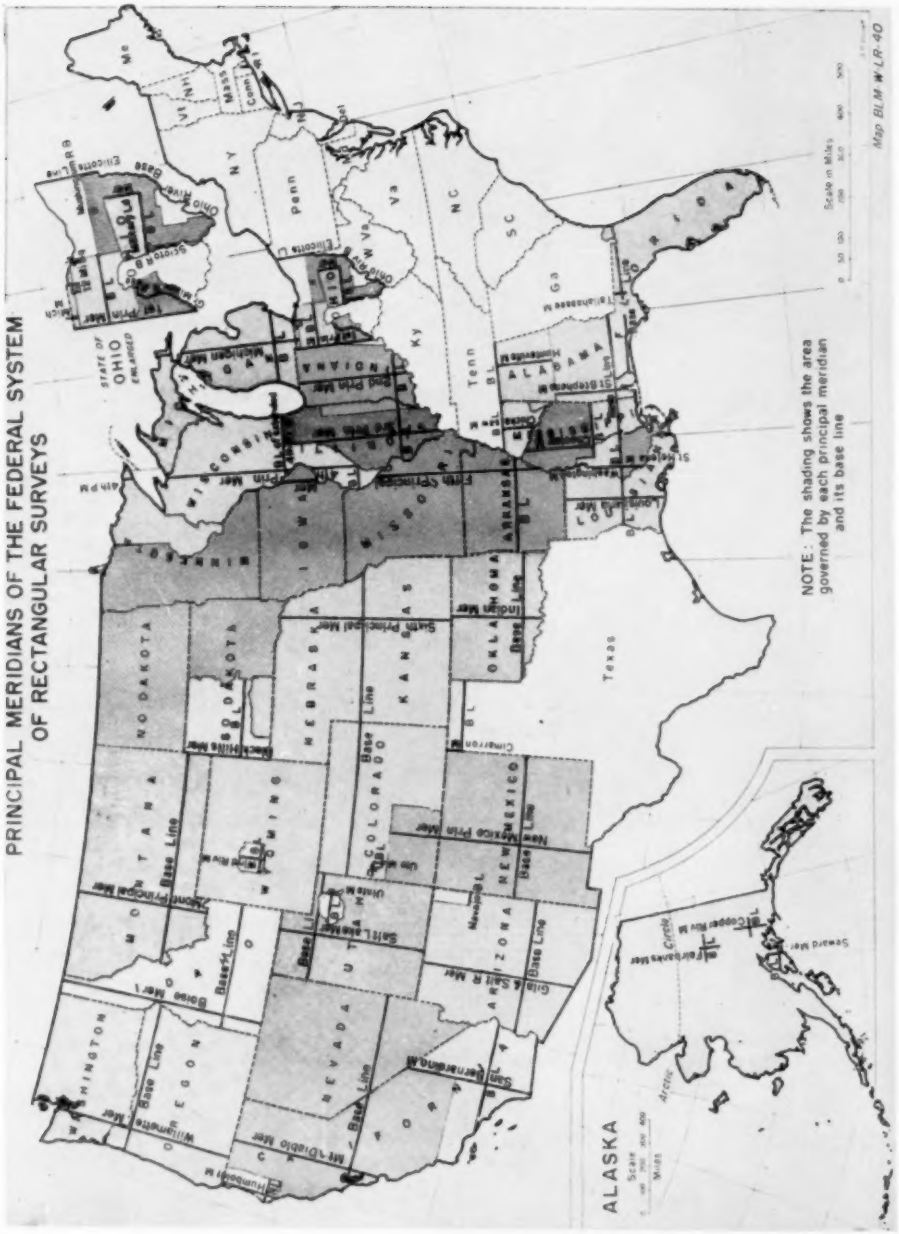
PRINCIPAL MERIDIANS OF THE FEDERAL SYSTEM OF RECTANGULAR SURVEYS
NOTE: The shading shows the area governed by each principal meridian and its base line
Map BLM W LR-40
ALASKA
Texas
Scale in Miles

4. The subdivision of the township into 36 sections by running parallel lines a mile apart throughout the township from south to north and from east to west.

The adoption of the rectangular system marked the important transition from the surveying practice that prevailed in most of the Colonies, where the land grants were defined by irregular metes and bounds, referenced to some natural object or to each other.

The part of the Northwest Territory which became the State of Ohio was the experimental area for the development of the rectangular system. Here the plans and methods were tested; and as the surveys progressed westward notable revisions of the rules were made applicable until the general plan became perfected.

There are 31 principal meridians and base lines in the United States and 3 in Alaska. These have been necessary because the various tracts of land comprising the public domain, acquired over a period of 60 to 70 years, had to be subdivided simultaneously in widely scattered areas.

EARLY SURVEYS

It is not possible to go into detail here concerning the early survey methods and instructions. The earliest rules were issued in manscript form and in printed circulars. More detailed regulations, which improved the plan in both accuracy and uniformity, were issued in the Manuals of 1855, 1881, 1890, 1894, 1902, and 1930. The latest is known as the Manual of 1947.[1]

Previous to about 1815, section lines were not required to close either on the range lines or on the township lines. This accounted for three corners in some cases: one corner established at the time the range line was run, a second governing the section to the east of the range line, and a third governing the section to the west. Tiffin's 1815 Instructions specify that the section west of the range line must close on the section corner established on the range line. Between 1815 and 1846, section corners apparently were not required to close on the west range line or on the north township line, which accounts for double corners in many cases. The 1846 general instructions, issued by the Surveyor General of Wisconsin and Iowa, required that all section lines close on the previously established corners on township and range lines, except on correction lines.

From 1786 until about 1836, all public-land lines were run with the magnetic needle. In 1836, Burt's solar compass is mentioned as having been used on some of the surveys.

The Act of May 10, 1800, provided, in effect, that any excess or deficiency should be noted and added to, or deducted from, the last half mile on the west,

[1] For a detailed account of the early surveys and methods, especially those dealing with the Middle West, the reader is referred to the book "Original Instructions Governing Public Land Surveys in Iowa," by John S. Dodds, *Iowa Engineering Society*, Ames, Iowa. This book contains copies of Tiffin's 1815 Instructions, also copies of the general instructions of 1831, 1834, 1843, 1846, and 1850, issued by the surveyors-general in charge of subdividing the Midwestern States. It also contains a copy of the first Manual of Instructions of 1855. "Public Land Surveys," by L. O. Stewart, *Collegiate Press, Inc.*, Ames, Iowa, is also recommended. This book deals with the history, instructions, and methods employed in making public-land surveys. "Original Ohio Land Subdivisions," by C. E. Sherman (Ohio Cooperative Topographic Survey, Vol. III, Final Report), *Columbus Press of the Ohio State Reformatory*, 1925, contains much interesting material concerning the development and application of public-land survey procedures.

when closing on the range line, and into the north half-mile, when closing on the township line.

Prior to 1855 there was no standard practice for spacing correction lines and standard parallels. In the older surveys, the correction spacing of the lines varies from 30 to 66 miles in different survey districts.

SURVEYS STANDARDIZED

In 1855, the first *Manual of Instructions* was issued by the General Land Office to regulate all public-land surveys. This manual specified use of the rectangular system of surveying in accordance with the procedures which had been developed. Obviously, this assisted greatly to unify and standardize the surveys. Previously, each surveyor general had issued separate instructions for his own district.

The following three important policies began to take shape in the 1855 instructions:

1. *Standard parallels spaced.*—"On the *north* of the principal base line, it is proposed to have these standards run at distances of every 4 townships, or 24 miles, and on the *south* of the principal base, at distances of every 5 townships, or 30 miles." Actually, it was not until about 1880 that this was put in force in all cases.

2. *Solar compass used.*—"Where uniformity in the variation of the needle is not found, the public surveys must be made with an instrument operating independently of the magnetic needle. Burt's improved solar compass, or other instrument of equal utility, must be used of necessity in such cases. . . ."

3. *Field checks started.*—"Unfaithfulness in the execution of the public surveys will be detected by special examination of the work to be made for that purpose, and, when detected, will immediately subject the delinquent deputy and his bondsman to be sued by the district attorney of the United States. . . ." Actually, these field checks did not become really effective until 1880.

After field checks were begun on surveys of public lands, several cases of outright fraudulence were discovered. The most flagrant frauds were in the work of the Benson Syndicate, which operated in California from 1873 to 1885.

In 1910, the General Land Office abolished its policy of contracting for the surveying of public lands and handed this task over to its cadastral engineers. The work of subdividing the public domain continues today as it has for the past 165 years.

Any discussion of the public-land surveys should take account of the survey dates and the instructions under which they were made. For instance, most of the public-land states east of the Mississippi River, together with Louisiana, Arkansas, Missouri, and most of Iowa, had been almost completely subdivided by 1855, or before uniform surveying procedures were adopted.

It is emphasized, however, that not all of the deputy surveyors followed instructions to the letter and many departed far from prescribed methods. Some were conscientious; others were not. One is likely to hear considerable adverse criticism from those who have only superficial knowledge of early public-land surveys; however, those with long experience in retracing the original land lines agree that the early surveys were well executed despite extremely poor living conditions, hazardous working conditions, low pay, and, even more important, the lack of uniformity in methods of procedure.

With the exception of the cadastral engineers of the Bureau of Land Management, who customarily make many resurveys and necessarily rerun many of the

original lines, the topographic engineers of the Geological Survey probably have the best opportunity to examine the evidence of the original public-land surveys on the ground over extensive areas. In general, the original corners were marked and perpetuated with wood, stone, or earth, depending upon materials available in the country being subdivided. In wooded areas, corners generally were marked with wooden stakes driven into the ground and witnessed by blazes and notches on adjacent trees. Although the stakes have disappeared long ago, many of the blazes and notches have endured and have proved to be lasting testimony to the location of the original corners. In the prairie country, where neither wood nor stone was available, corners were perpetuated with mounds of earth built over a charcoal core and with pits dug around the mounds. Although these were good marks if left undisturbed, comparatively few escaped destruction by buffalo, cattle, or rainfall. Then, too, many were destroyed by the settlers' plows and by construction of roads on section lines. The marking of bearing trees and the placing of stones to mark corners have proved to be, by far, the most lasting and valuable markers for identification of early surveys.

In placing the network of public-land surveys on topographic maps, the Geological Survey often finds many variations from those shown on official plats. It is obvious, from time to time, that a chain's length has been inadvertently added or dropped by the original surveyors. Also, the azimuth of land lines shown on the official plats in many cases are not in agreement with those same lines on the ground. Variations of several degrees from the prescribed courses shown on the plats have been noted. This was probably caused by "local attraction" of the magnetic needle, which the original surveyors had not detected.

PLACING NET ON MAPS

Geological Survey engineers are called upon to solve some complex and perplexing problems in connection with the placing of the land-line net on topographic maps. In order to maintain a standard practice, certain rules and regulations have been adopted, of which the following is a résumé.

In publishing public-land line data on topographic maps, the Geological Survey recognizes three types of land corners, as follows:

1. A *true* corner is one where the original or officially re-established monument or mark is found, or its location is definitely identified by one or more original reference marks, and it agrees with the description given in the field notes or as indicated on the plats of the official survey.

2. An *accepted* corner is one that is accepted and used locally but cannot be found or identified by the official monument or marks. Corners marked by pine knots, stakes, unmarked monuments, blazed trees, fence corners, etc., which are accepted as the correct location of the corners, are included in this class.

3. A *theoretical* corner is a public-land corner for which no mark is found or identified on the ground.

The first two types of corners are designated on topographic maps by a small right-angle cross oriented with the intersecting land lines but of a heavier weight, except where they are located in a road. The third type of corner is indicated only by the intersecting land-line symbol.

Meander corners were established on public-land lines at the banks of rivers —with a right-angle width of 3 chains or more—and at the banks of lakes, bayous, and ponds having areas of 25 acres or more. When recovered, these corners are

shown on topographic maps by the same symbols used to show township, section, or quarter-section corners, that is, by a small cross.

Land-grant corners and corners of reservations, when found and identified in the field, are shown with the boundary monument symbol—a small square with a dot in the center.

When applications for patents to mineral lands are made in areas where public-land corners or other monuments are 2 or more miles distant and the deposits occur in ore-bearing rock veins, known as lodes, monuments are established by official mineral surveyors, and boundary monuments of the several claims are tied to them. These reference monuments are known as United States location monuments, marked "USLM," or United States mineral monuments marked "USMM." Each also bears a serial number for identification. A small, solid isosceles triangle is used to show these monuments on topographic maps.

LAND LINES SHOWN

Land lines are shown on topographic maps by the solid-line symbol, under the following conditions:

1. When the lines have been located or identified in the field.
2. When they connect true and accepted corners which have been located in the field.
3. When the number of located true and accepted corners is adequate to permit a reasonably accurate adjustment of the land lines as established, that is, when 50 percent or more of the line crossings of natural and cultural features, as shown on the official plat, closely agree with the same crossings on the map positions of the corresponding lines.

When only 20 to 50 percent of the intersections of land lines and cultural or natural features, as shown on the official plats, agree with the same intersections as shown on the topographic maps, a dashed-line symbol is used. This indicates that there was insufficient or conflicting evidence concerning the true map location for the land lines in that area.

In order not to discredit other information shown on the maps, it is sometimes found advisable to omit the land lines. This is especially true when there is conflicting evidence of their location, evidence of extremely poor or fraudulent surveys, or when it is impossible to locate enough corners in the field. Although each case is judged on its own merits, land lines generally are omitted from topographic maps when less than 20 percent of the intersections of land lines and natural or cultural features as shown on the official plats agree with the same intersections as shown on the topographic maps. Such intentional omissions are noted by explanations on the bottom margin of the maps.

Although meander corners, established on the public-land lines, are shown on topographic maps, meander lines are not shown, because, in the original surveys, they were not run as boundary lines but were used to define the sinuosities of bank or shoreline and to ascertain the quantity of land remaining after segregation of water areas. Land lines are drawn on topographic maps to the meander corners and stopped there, if the corners are recovered. If not recovered, the lines are drawn from the nearest section corners toward the meander water area and stopped at the recorded distance as shown on the plats. Thus, lines are shown only to the extent that they were originally established. Where shorelines have changed since the original surveys were made, the lines sometimes extend into or across bodies of water, and sometimes stop short of the present shoreline.

LAND–GRANT LINES

Certain tracts of land within the area of the public domain were privately owned, and when titles to these tracts were confirmed, they were excluded from public-land surveys. Boundaries of these "land grants" are shown on topographic maps by the land-grant boundary-line symbol—a quarter-inch dash separated by two dots.

In some cases, titles to these grants were not verified until after public-land surveys were made. Such surveys are official, and appear on approved plats and field notes of the Bureau of Land Management. However, they have no legal status as public-land surveys, because the authentication of title to a grant definitely excluded its area from public ownership and from any other disposal by the Federal Government. In such cases, these land lines may be shown on topographic maps as useful cultural information.

Under other conditions, large grants have been subdivided by private individuals in general accord with the practice of the Federal public-land surveys. Although ordinarily omitted, such subdivisions may be shown on topographic maps if they cover large grants, conform closely to public-land pattern, are the basis for the road network, or for other similar reasons.

The reservation-line symbol is used to denote boundaries of areas such as Indian, military, or lighthouse reservations, and national parks and monuments when titles have been transferred by the United States before the public-land surveys were made. The reservation-line symbol is denoted by $\frac{3}{5}$-inch dashes separated by single dots.

In some cases, reservations which existed when original public-land surveys were made have since been abandoned, or their boundaries have been changed. These lands then reverted to public-land status and may have been subdivided later. In these cases, locations of old boundaries and section lines established within them are shown by the section-line symbol.

PUBLIC–LAND SURVEY RULES

As early as 1805, Congress enacted legislation establishing certain basic principles concerning public-land surveys, as follows:

1. That *the boundaries and subdivisions of the public lands* as surveyed under approved engineers, the physical evidence of which survey consists of monuments established upon the ground, and the record evidence of which consists of field notes and plats duly approved by the authorities constituted by law, *are unchangeable after the passing of the title by the United States.*

2. That *the physical evidence of the original township,* section, quarter section, and other monuments must stand *as the true corner of the subdivision which they were intended to represent,* and will be given controlling preference over the recorded directions and length of lines.

3. That *the length of these lines as run and marked shall be considered as the true length thereof,* even though later surveys might find them in error.

The fundamental principles should be, if they are not, the rule and guide of all land surveyors and engineers when they attempt to restore or recover lost land lines or corners. The law cited above clearly states that the function of the present-day surveyor is not to question the accuracy of original public-land surveys but to restore the lines and corners to their original positions.

In accordance with the above principles, the Geological Survey treats unfound corners as lost corners and attempts to restore them on its topographic

maps by means of a paper adjustment in the same manner and by the same rules as those given for the restoration of lost corners on the ground.

In the Bureau of Land Management's 1947 *Manual of Surveying Instructions*,[2] a lost corner is defined as that point of a survey the position of which cannot be determined beyond a reasonable doubt, either from traces of the original marks or from acceptable evidence or testimony bearing upon the original position, and the location of which can be restored only by reference to one or more interdependent corners.

The 1947 *Manual of Surveying Instructions* contains a chapter dealing with the restoration of lost corners. Also, a special circular, entitled "Restoration of Lost or Obliterated Corners and Subdivisions of Sections," has been prepared by the Bureau of Land Management. This circular was prepared as a guide for county and other local surveyors engaged in retracing and restoring lost or obliterated public-land survey corners. Both of these publications are used by the engineers of the Geological Survey to adjust the land-line network on topographic maps.

The more corners found and located on topographic maps in the field, the more reliable will be the placing of land lines on published maps. In settled country, where land lines often become property lines, there are section-line roads and fences, and construction of a public-land survey net is usually simple. Since about 1940, practically all base maps used by topographic engineers of the Geological Survey have been compiled from aerial photographs by photogrammetric methods. The basic compilations show all roads, fence lines, timber lines, and the entire drainage pattern, all in rigid conformity with each other and tied to triangulation and transit traverse. In well-settled agricultural areas, the pattern of the land net is usually obvious, making it necessary only to identify and supplement this information in the field.

In unsettled country or in settled areas where roads or fences seldom conform to public-land survey lines, enough corners have to be found on the ground and located on maps to enable engineers to construct a land net built up from the official plats and notes and tied to the found corners. The usual procedure in such areas is to construct, on an oversheet of transparent paper, the entire land net of the area to be mapped. Such a tracing, held in position over the field sheet by the plotted locations of those corners which have been located, will indicate graphically the theoretical location of all other corners. As more corners are found, the further placements of the tracing become increasingly serviceable as a guide.

Geological Survey engineers are required to make a reasonably diligent search for as many corners as possible, without expending too much time and money. The necessity of making local inquiry from landowners, old settlers in the community, and county and local land surveyors and engineers is stressed. In regions of national forests, contacts are made with officials of the Forest Service regarding locations of public-land corners which they have found or have not found. A sincere effort is made to locate all township corners in the area being mapped because these are the controlling corners for the interior sections.

After diligent search has been made and as many corners as possible located,

[2] Superintendent of Documents, *U. S. Government Printing Office*, Washington, D. C.

and after these are in place on the map, the remaining corners are treated as lost corners. Section-line crossings at the lost corners are adjusted in place between the found corners, either by single proportional measurement (on lines established with reference to definite alignment in only one direction) or by double proportional measurement (on lines established with reference to two directions as township corners common to four townships and interior section corners).

On principal meridians, guide meridians, base lines, standard parallels, and township and range lines, lost-corner locations are adjusted in line between the nearest known corners on the same line and at distances from them proportional to those shown in the field notes and on the plats of the original survey.

Lost township corners, common to four townships, and interior section corners are adjusted at distances from the nearest known corners, north, south, east, and west, proportional to those shown in the field notes and on the plats of the original survey. Lost township corners common to only two townships are adjusted in line between the nearest known corners on the same line and at distances from them proportional to those shown on the plats and in the notes.

ACCURACY IN PLOTTING FOUND CORNERS AND LINES

On topographic maps of recent date, public-land survey found corners and lines are plotted on the maps with the same accuracy as other well-defined objects, that is, to a standard which specifies that 90 percent of all well-defined points be plotted in correct position within 40 feet to scale on maps published in 7½- or 15-minute quadrangles. With modern photogrammetric compilation methods, this standard is attained, although topographic maps made and published before photogrammetric methods were used probably do not conform to these specifications in some cases. Neither did the Model-T Ford perform as well as the 1950 model Ford, but the Model-T was a fine car in its day.

The Geological Survey also publishes a series of planimetric maps on which contour lines are not shown. Public-land survey lines are shown on these in the same manner as on topographic maps.

* * *

Microfilming Preserves U. S. Land Records

SOMETHING over 6,000,000 deeds covering every parcel of public domain land granted to citizens of the United States since 1788 are now being microfilmed by the Bureau of Land Management of the Department of the Interior.

The process, according to the Eastman Kodak Co., whose equipment is being used, covers every piece of property in Alaska and the United States, except the District of Columbia, Texas, and 18 Eastern States, which can be traced to these deeds in Washington. Many of the old records are disintegrating, as they are constantly handled in answer to an average of 500 inquiries a week from historians, novelists, realtors, lawyers, and title guarantee companies.

Copies of the deeds are now maintained in 11,700 bound volumes, occupying hundreds of feet of shelving and considerable floor space. When reduced to 100-foot rolls of 35 mm. microfilm, the entire record can be stored in 10 film files of 6 drawers each.—*Engineering News-Record*, July 27, 1950.

Reflections of a Canadian Geodesist

By C. H. NEY

CHIEF, TRIANGULATION ADJUSTMENTS DIVISION, GEODETIC SURVEY OF CANADA

BOTH precise and second-order astronomy are used extensively in carrying on geodetic survey work in Canada. Formerly, all astronomy used in connection with operations of a geodetic nature involved precise determinations. In recent years, astronomical fixations of second-order accuracy are being used for ground control for small-scale mapping in remote northern areas not readily accessible for the projection of triangulation arcs.

One of the principal uses of precise astronomy is the establishment of Laplace azimuth stations for the control of "twist" in our triangulation nets. At Laplace stations, the astronomical latitudes,* longitudes, and azimuths are determined with a high degree of precision. The well-known relationship between the true geodetic azimuth of a line and the corresponding astronomical azimuth, as given by Laplace, a former French geodesist, is

$$a_G = a_A + (\lambda_A - \lambda_G) \sin \phi,$$

where $(\lambda_A - \lambda_G) \sin \phi$ is a correction to the astronomical azimuth, due to the local deflection of the vertical in the prime vertical plane. In Canada, the corrective term has been found to vary from 0 to about 22″.

INSTRUMENTS

At each Laplace station, the latitude and the local sidereal time are determined from observations with Heyde broken-axis type astronomical telescope oriented in the plane of the meridian. This instrument, which is somewhat similar to the Bamberg astronomical telescope used by the U. S. Coast and Geodetic Survey, is equipped with a self-registering transit micrometer, by means of which the chronometer times of star transits over the meridian are registered on an electric chronograph. For the longitude determinations, the radio time signals from the Dominion Observatory at Ottawa, the Arlington Naval Observatory, or the Bureau of Standards at Washington are received by the extinction method, using for the aural vernier effect a comparison chronometer rated to gain 1 second in 50 on mean time. Before and after the reception of the radio time signals, the comparison and master sidereal chronometers are compared by running them simultaneously on the chronograph.

Observations for latitude by Talcott's method are made with the same instrument. The value of one division of the latitude level is of the order of 1.″2 of arc. The probable error of a position fixation with the Heyde astronomical telescope is usually between ± 0.″05 and ±0.″10, depending upon the number of stars observed, and the skill of the observer.

For precise azimuth work, a 3-micrometer instrument, such as the 12-inch-diameter Kern, reading to single seconds and estimated to tenths of seconds, has been used to a great extent in the past. Recently, the 5¼-inch Tavistock theodo-

Presented at Tenth Anniversary Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 21–23, 1950. (Paper read by Wilson Humphries, in the absence of the author.)

* Although not required for the Laplace work, the astronomical latitude is required for the study of the deflections of the vertical.

Heyde astronomical telescope and accessory instruments set up at Aretic Bay, near the north end of Baffin Island, with observatory tent removed.

lite made by Cooke, Troughton and Simms in England, and reading to one-half second, has been tried out. As the distance between the supports of the striding level on this instrument is only 5⅛ inches, it is not entirely suitable for precise azimuth work in high latitudes, where the striding level correction becomes more difficult to evaluate.

In recent years, some European geodesists have found that astronomical azimuths of greater precision may be obtained by making the observations from the tops of tripods 20 to 60 feet above the ground. As an innovation during the past summer, a precise azimuth was determined in Canada, partly by observations from the top of a 20-foot wooden tripod centered inside a standard-type tower and partly from a set-up on the ground below. Unfortunately, insufficient observations were taken from the ground station to assess accurately the difference in precision derived from the two sets of observations. The range in each case was about 8″ of arc, and the probable error of the mean of all the combined observations was ± 0.″32. Usually, our precise azimuths are determined with a probable error of ±0.″25.

For the determination of basic data in the study of isostasy and other related problems, precise astronomical latitudes and longitudes are observed at carefully selected triangulation stations located at fairly uniform intervals over the country. Deflections of the vertical up to 20″ of arc have been found to occur along the north shore of the Gaspe coast in Quebec, and in Newfoundland. The average value of observed deflections in the Province of Quebec is 4.″61, the extreme values being + 20.″86 and – 16.″59. As determined from 267 precise astronomic-geodetic stations in Canada, the average deflections, without regard to sign, are 3.″3 and 3.″1 in the meridian and prime vertical planes, respectively.

DEMARCATION OF BOUNDARIES

In the demarcation of provincial boundaries, precise astronomy has been used occasionally to establish strategic points on the ground in accordance with the terms of their legal definitions. For example, there is that portion of the Ontario-Manitoba boundary described by Act of Parliament in 1912 as a straight line joining the extreme east end of Island Lake with the point at the intersection of the west coast of Hudson Bay and the 89th Meridian of west longitude. In 1929, the astronomical field party, under instructions from the Ontario-Manitoba Boundary Commission, landed by plane at the east end of Island Lake, established a survey monument at the extreme east end, and made a precise determination of its position.

To locate the point on the Hudson Bay coast, the party was obliged to travel from the Hudson Bay Railway by canoe, a distance of 300 miles down the Nelson River and along the Hudson Bay coast to the locale of the boundary terminal. The area adjacent to the coast, and for many miles on either side of this section of interprovincial boundary, is undeveloped territory frequented only by a few hunters, prospectors, and Indian trappers. For transportation along the coast, 22-foot freight canoes driven by outboard motors were used.

Travel by canoe along the west coast of Hudson Bay is seldom monotonous or dull. In planning the day's voyage, the nature of the coast and the variation in the depth of the water due to the tide must always be kept in mind. In most sections, the tide at low water leaves bare from 1 to 3 miles of boulder-strewn mud flats. The coast is, in general, no more than 4 or 5 feet above the high water mark. In some places, it is less.

The day's journey is usually commenced by breaking camp at dead of night. The hour of high tide is zero hour, for then only is there sufficient water to float even shallow-draft boats near shore. Heading straight out to sea, the heavy canoes are poled or paddled into relatively deep water from 2 to 5 miles offshore, where it is safe to start the motors. It is customary then to run on compass bearings paralleling the coast line.

By dawn, the voyagers are often well on their way. It is still necessary, however, to steer by the compass, as the low, flat shoreline is often indiscernible from a canoe at a distance of 5 miles. The day's journey, once commenced in this manner, cannot be terminated at will. Until the tide comes in, the canoes must be kept at sea. Rain, wind, waves, or tranquil, sunny weather must be faced alike in the open. By commencing the "travel day" before daylight, it is usually possible to make a landfall 11 or 12 hours later, with the attending advantage of good visibility. In extreme cases, where dangerous, howling gales and heavy seas threaten to swamp the canoes during the course of a day's run, a landing may sometimes be made through the surf on the mud bars. In such cases, the canoes would usually be wrecked and the cargoes damaged or lost. However, the Hudson Bay type of heavy freight canoe, 20 to 22 feet in length and capable of carrying ¾ ton, is no eggshell, and has been found capable of weathering surprisingly high seas.

In going from the mouth of the Nelson River easterly towards the objective at the boundary terminal, it was necessary to stop at York Factory trading post near the mouth of the Hayes River. Arriving near the entrance of the Hayes at ebb tide, the party experienced some difficulty in finding the main channel of the river. After several futile attempts had been made, the flotilla of canoes was

Aerial view showing position of astronomical observation station (within the circle) established at Coutts Inlet, Baffin Island. The snow-covered tableland is 3,000 to 4,000 feet above sea level.

left high and dry on the mud flats by the receding tide. Realizing that they were confronted with a 10- or 11-hour wait until the next high tide, the personnel of the party set up their folding cots, unrolled their sleeping robes, and enjoyed an 8-hour sleep on the bottom of Hudson Bay, 3 miles out from shore.

A few days later when the party neared its objective, a preliminary astronomical observation was made ashore. After a short move, a camp was established, and a concrete pier for the Heyde astronomical telescope was built at the calculated position of the boundary terminal. Four independent determinations of longitude were made on each of four different nights. About 24 stars were observed in each case, including five or six polars. For latitude, 35 pairs of stars were observed by Talcott's method. The observations were all reduced in the field, and a permanent concrete monument built at the intersection of the 89th Meridian and the high water mark.

The length of the theoretical geodetic line joining the Island Lake and Hudson Bay terminal monuments is 282.37 miles. In 1947, 18 years after the terminal points had been established astronomically, the connecting line was opened on the ground by the Boundary Commission. Commencing at the Island Lake boundary monument on the theoretical azimuth, the transit line was run as straight

Astronomical station protected by cairn. Cross is painted white for identification from the air.

as possible. Corrections, based on astronomical azimuth observations, were made periodically to prevent accumulation of errors of line projection. At the end of the 282 miles, the line struck the Hudson Bay coast only 16 feet to one side of the boundary terminal monument. Most geodesists and surveyors will agree that a large element of good luck was involved in this unexpected result.

CONTROL FOR MAPPING

Second-order astronomy was seldom used by the Geodetic Survey of Canada prior to the commencement of the last war. Since then, it has been used to a great extent for the establishment of ground control for small-scale mapping of Arctic and sub-Arctic Canada. On this type of position fixation work, a precision theodolite clamped at a fixed vertical angle of 45° or 60° is used to observe the transits of a number of stars over the horizontal wires of the instrument. One star observed in each of the NE., NW., SE., and SW. quadrants permits of the determination of the latitude and the correction to the sidereal chronometer. On a single night, about eight stars are observed in each quadrant, thus giving a like number of independent determinations of latitude and longitude. The probable error of a fixation from 20 or 30 stars is of the order of 1″ of arc.

On this type of work, flying boats and pontoon-equipped airplanes are used for transportation almost exclusively. Occasionally, small motor-driven schooners are employed for short trips from trading posts located on the sea coast. For most of the work in the northerly areas, transportation is provided by the Royal Canadian Air Force. Norseman pontoon-equipped planes and Canso flying boats have proved to be suitable aircraft. The Canso has carried 22 men with considerable camp equipment and made a non-stop flight of 1,000 miles.

Control points are chosen, where possible, on the ends of well-defined points jutting out into lakes, rivers, or the sea. Small islands or the ends of narrow bays are also suitable sites. Ready identification of the observation stations on

aerial photographs is the important consideration. Before leaving the station, the observer makes a local ground survey to determine the orientation and scale of lines joining prominent topographical features.

By the end of the 1949 field season, 267 primary and 630 second-order astronomical stations had been established by the Geodetic Survey of Canada in various parts of the country. The Topographical Survey was also active for a number of years in the establishment of second-order astronomical control points in unmapped areas.

PLACE NAMES—AN HISTORICAL CHRONICLE

The place names shown on maps of Northern Canada reflect the hardships and dangers endured by the early explorers on their voyages of discovery and their search, north of the Canadian mainland, for a "Northwest Passage" which would link England with the Orient. It would be interesting to know what particular deliverance from imminent peril prompted the name "Bay of God's Mercy"; what momentary success was represented by the name "Cape Hopes Advance." Incidents of great historic interest are also recalled by the place names on these maps.

Two hundred and fifty miles northwest of the Ontario-Manitoba boundary terminal is the port of Churchill, linked with the main Canadian Railway network by the section of line extending northward 300 miles from the town of The Pas.

Adjacent to the port situated inside the entrance of the Churchill River, the waters of Hudson Bay are of sufficient depth to permit ocean-going vessels to approach the shore. The entrance to Churchill Harbor is deep and free of obstructions, giving ready access to a very fine harbor. From Churchill, across Hudson Bay and through Hudson Strait, it is 1,100 miles to the open waters of the Atlantic Ocean.

On the west side of the 1,500-foot entrance to the harbor stand the ruins of old Fort Prince of Wales. On the opposite shore is the site of Cape Merry battery. The fort and battery are of great historic interest. The construction of the large stone fortress, built in the form of a square with sides about 314 feet

The Canso amphibian plane used by the Royal Canadian Air Force for the transportation of Geodetic Survey parties in the Canadian Northland.

Department of Resources and Development

Fort Prince of Wales was built about 1733, destroyed in 1782, and restored as an historic site by the Canadian Government in 1933.

long, was commenced in 1733 by the Hudson's Bay Company and its erection was supervised for a number of years by the celebrated Samuel Hearne. The walls averaged 40 feet in thickness; on the parapet 40 cannon were mounted. This large and expensive fortification probably was not built by the Hudson's Bay Company solely for the protection of its own interests, but rather for the purpose of complying with the terms of its Royal Charter, which required that it fortify the country.

With such a fortification, Churchill would naturally be deemed impregnable in those days; yet history informs us that the French, under the command of La Perouse, suddenly appeared on August 8, 1782, with three sailing vessels of war, manned by scurvy-stricken crews, and demanded an unconditional surrender. The amazed garrison of 39 men complied with this demand. Without firing a shot, they threw open the gates, whereupon the French took possession, spiked and dismounted the guns, burned the barracks, and sailed away to France with Hearne, his men, and all their valuable furs.

Until 1933, the fort remained much as it had been left by La Perouse, its massive walls an imposing landmark on a bleak and treeless promontory, the heavy guns, mere masses of rusting iron, lying among the crumbling masonry and stonework. In 1933, the Canadian Government commenced the rebuilding of the crumbling walls, re-mounted the cannon, and made the fort into one of the nation's historic sites.

THE LITTLE BROWN NATIVES OF NORTHERN CANADA

North of a line through Hudson Strait, the Belcher Islands in Hudson Bay, and Port Churchill, the native population is almost entirely Eskimo. These are the first residents—the little brown men and women whose ancestors came over on the Arctic "Mayflower" from Mongolia many centuries ago and landed on the east side of Bering Strait. The white man, who penetrates occasionally into the

Arctic, is ever amazed that any race of human beings has been able to survive for centuries the merciless assaults of the searing Arctic winters without help from outside sources.

In general, the Eskimos are a remarkable race. It is true that their ideas of personal hygiene are greatly different from our own; that their diet is composed, to a great extent, of raw fish and meat. It is also true that, up to the last decade, they practiced the free and easy exchange of wives. Notwithstanding these earmarks of a primitive civilization, they have developed to a marked degree many admirable traits of character. Friendly, faithful in time of stress, reliable, and generous in comparison with their humble means, the Eskimos' conduct has been cited many times in history as an example worthy of the greatest praise. During the last two decades, Catholic and Anglican Church missionaries have penetrated into the Far North. Missions have been established at several trading posts in the sub-Arctic, where resident doctors and school teachers administer to the physical and mental welfare of the native population. Already, a marked change has been noted in the morals and personal cleanliness of all those falling within the missionaries' influence.

The economic prosperity of the Eskimo varies from year to year. In times when fur prices are high and the trapping seasons favorable, some families have been known to earn annual incomes up to $5,000. A few of the more enterprising hunters and trappers have been able to purchase auxiliary motor-powered schooners of about 10-ton displacement. These boats are used during the short summer seasons on migrations along the Arctic Coast. Sewing machines, phonographs, and radio sets are becoming standard articles of trade in most sections of the North.

Strangely enough, the Eskimo does not relish the long Arctic winter night. His interest in the celestial bodies is concentrated on the sun rather than on the stars. For this reason, he does not care to inhabit regions north of Baffin Island, where an adequate food supply of fish and seal is hard to obtain.

In the last decade, a great change has been going on in the Far North. Along with the fur trader and the Royal Canadian Mounted Police, the geodesist, the geologist, the hydrographer, and the aerial photogrammetrist are all doing their share to roll back the frontiers of Canada's Eskimoland.

FOURTH SHORT COURSE CONDUCTED AT GEORGIA TECH

The Fourth Short Course in Surveying and Mapping was held March 22–24, 1951, at Georgia Institute of Technology, Atlanta, Ga. The Course was conducted by the School of Civil Engineering of Georgia Tech and the Georgia Association of Registered Land Surveyors in cooperation with the Engineering Extension Division.

The event was sponsored by the American Society of Engineering Education, Committee VIII; the American Congress on Surveying and Mapping; the American Society of Civil Engineers, Georgia Section; the Georgia Society of Professional Engineers; and the Georgia Engineering Society.

Metes-and-Bounds Location Problems in New England

By GORDON E. AINSWORTH

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I BELIEVE THAT MOST OF US have been guilty, at one time or another, of the human fault of taking things for granted. Such has often been my case where the definitions of technical terms as well as words common to everyday usage were concerned. Thus handicapped at the introductory stage of this paper, I consulted our ever-reliable friend Noah Webster as to his interpretation of the meaning of the words "mete" and "bound," with the following significant results:

When used as a transitive verb, "mete" is simply defined as "to measure," while as a noun its meaning may be taken as "goal" or "boundary." "Bound," on the other hand, may be defined and interpreted in such a variety of ways as to make its meaning quite ambiguous, reflecting, perhaps, the conditions that we actually find in the field.

For the benefit of the members of this organization who are not acquainted with metes-and-bounds location problems in the New England area, I think it advisable to begin with a brief history that will have a direct bearing on the subject matter to follow, the bulk of which has been taken directly from our files and experiences in the field.

ABSTRACTING PREVIOUS CONVEYANCES

Let us start with abstracting, or "deed data work" as we call it. For the most part, deeds are recorded at registries, usually situated in the shire towns or county seats, although in unusually large counties one or more sub-registries may be located adjacent to larger centers of population for added accessibility and convenience. Vermont is an exception to this rule, however, for here we find almost all land conveyances recorded at either the town clerk's office (if the town is of sufficient size to provide this accommodation) or at the residence of the current incumbent. Whenever it becomes necessary during line of duty to utilize the latter facility, the surveyor often has to adapt his schedule to the local domestic activities and at the same time pay a fee of 50 cents for the so-called privilege of examining the records. Where the records are cached at a local town office, it often requires considerable sleuthing to track down the errant custodian of the town's valuable papers, particularly during fishing season or haying time. Moreover, there is never any guarantee that the services of this important town official, once secured, will continue to be available in one's hour of need. While this situation may be somewhat amusing, it is highly inefficient and will take a long time to correct, Vermonters being what they are.

If the town or county repository of records happens to be one that is unfamiliar to the surveyor, more time will be fruitlessly expended in decoding the filing system. These index systems vary considerably within the states and among the towns of New England so that a stranger to any registry must first spend valuable

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time in orientation before attempting any really productive work. Once he starts his examination, the surveyor is very apt to be confronted with a succession of conveyances, both fragmentary and contradictory, from which he must try to obtain the necessary quantities and evidence to construct a working description for a resurvey. For instance, in the Connecticut Valley towns of western Massachusetts, it is often necessary to go back as far as 1790 before a deed giving a reasonable metes-and-bounds description can be found, all intervening conveyances being described merely by references or having boundary calls referring to abutters only. In various other parts of New England research into past conveyances takes the seeker back much farther than the Bunker Hill days. It is obvious that the material gleaned from these painstaking examinations is of value only where the existing monuments can be definitely verified by the original description, a fact that is very often hard to prove. Conveyance by boundary or abutters descriptions, together with mere references to past deeds, is an unpleasant and much-too-common feature of our methods. The blame for these deficiencies rests squarely upon us and upon the legal profession. It is going to take a great deal of missionary work and cooperation, both within our profession and without, to correct these conditions and provide a more stable foundation for the future.

BOUNDARY MARKING AND DEFINITION

Supposing that the surveyor has been reasonably successful in obtaining a working description for a resurvey, his next problem, of course, is to correlate this data with evidence in the field. Here the headaches are apt to begin in earnest. Boundary markers are of many types and descriptions. At present we find iron pipes to be most commonly in favor, although reinforced concrete monuments are becoming more popular and are superseding the old, reliable marble and granite markers. Other types include stakes and piles of stones; car axles; gun barrels; iron pins of all types and sizes; staddles; stumps and blazed trees; intersections of walls and wooden, rail, wire, and brush fences; and, I strongly suspect, in some instances, heel prints. On at least one occasion a corner was defined by deed as a hole in the ice. This is not so fantastic as it sounds, however, for the point was located in a remote part of northwestern Maine where the winters are long and the ice thick; the reason for the hole was simply the existence of a warm spring that prevented freezing under normal conditions.

Boundary lines in the inland regions are as varied as their descriptions and are commonly marked or defined by stone walls; wire, rail, brush, board and stump fences; ditches; plowed furrows and headlands; blazed trees; differences in timber type or age of forest stands; hedge rows; banks and threads of streams; high- and low-water marks along the shores and banks of large rivers, lakes, and ponds; tops of ridges and mountains; ledge outcrops; center lines and right-of-way limits on ways and highways—in fact, by almost any interesting and convenient succession of objects or topographical features that may appeal to lazy and ingenious human minds at the time that a description for a conveyance is being drawn up. Our coastal surveyors, notably the Cape Cod group, can cheerfully furnish us with many more interesting items in this category, all of which add up to such a state of confusion that we often wish we could afford to hire the consulting services of a competent crystal-gazer or tea-leaf reader.

Thus far I have attempted to give you an unexaggerated picture of metes-and-bounds conditions in New England indigenous to our rural areas. In the urban

sections, I am happy to say, conditions are more stable. Business and industrial tracts, together with residential subdivisions, are tied into or referenced by bounded ways and highways through a more uniform system of metes-and-bounds descriptions, allowing reasonable errors of closure and marked by suitable monuments and control points. Whereas magnetic bearings and the units of the old Gunters' chain commonly define the boundaries in rural areas, interior angles and linear measurements to hundredths of a foot describe urban lots. Within the past few decades the Massachusetts Land Court has established a schedule of standards for both field and office work that is improving the general quality of survey work throughout the Commonwealth.

SOURCES OF DIFFICULTIES

Now let us attempt to set forth some of the reasons underlying the errors and deficiencies in present metes-and-bounds descriptions. Unfortunately, our profession is no different from any other when it comes to confusing facts with personalities. In many instances—and this contention can be easily documented—serious errors of both omission and commission have resulted from the failure of surveyors to cooperate not only with one another but with their clients and the legal profession as a whole. In Massachusetts, as in most other states, a surveyor has no legal status as far as the courts are concerned other than that of an expert witness. This means, of course, that he cannot prepare any deed material other than a description of a survey, which he may supply to a law office and hope that the good counselor may deign to use at least part of it in the preparation of the instrument. It has always seemed ironical that the person having the greatest professional interest in the metes-and-bounds description contained in any deed conveyance has no legal right to prepare it except upon request, and is entirely dependent upon the whims and fancies of another profession for all documents essential to the execution of his work.

Preparation of Descriptions and Maps

We all know that a doctor's prescription will be filled according to stipulated methods and quantities at any drug store in the country, and we likewise know that if a technical description by metes-and-bounds of a tract of land were submitted to a dozen different law offices it would eventually wind up with the same number of interpretations on a legal form of conveyance. By way of illustration, we recently submitted one of our survey descriptions to a large legal firm specializing in land transactions, abstracting, and conveyancing. This firm always prefers to rewrite the surveyors' descriptions, retaining verbatim only those portions that meet with their approval. In this case their specialist tried to rewrite the entire traverse, failed to compare it with our original, and wound up by including a substantial portion of the abutters' tracts. The result was red faces with no apologies; the remedy is confirmatory deeds.

One other recent case of a similar nature will serve to illustrate further our point concerning facts and personalities. A local attorney noted for his aversion to surveyors recently attempted to prepare a description for a parcel of land to be subdivided out of a 5-acre tract. It was his intention to describe a house lot with a frontage of about 180 feet on a semi-urban town way, using his memory rather than facts and figures to prepare the subdivisional description. Unfortunately for his client, he was wrong on all counts because he was thinking in

terms of yards (a layman's unit of measure) and described the length of the lines in terms of feet. The client belately decided to have a survey made after he had built a cozy home on one side of his lot, the wrong side of course, because his new home isn't within 60 feet of the land actually conveyed to him. You are familiar with cases of this nature, and I hope that these illustrations may not prove boring. It is reassuring, however, to note that in recent years many of our law offices in western Massachusetts, as well as in New Hampshire and Vermont, are welcoming surveyors' descriptions and recommendations.

Another common source of trouble lies in the fundamental incompetence of many persons directly concerned with survey work and the preparation of plans and descriptions. We have just completed mapping nearly 900 tracts of land, comprising some 22,000 acres, for the assessors of a central Massachusetts town. Inasmuch as we have found nearly 60 percent of the deeds in error, we have undertaken to determine some of the reasons for this condition. In the majority of cases the root of the trouble stems from sloppy conveyancing and poor surveying. You know who is to blame and why.

Relationship of Surveys to Land Values

With respect to field work for resurveys, we are all well aware that a thorough understanding and working application of the allowable limit of error is essential. It is obvious that methods and tolerances suitable for surveys of urban lots are economically unsound when applied to sub-marginal rural tracts. A survey that costs $5 an acre on land worth half that figure doesn't win much favor with the average New Englander. Conversely, survey methods used for wooded land certainly aren't applicable to urban areas. A few years ago I was doing some work for a large utility company in northern New Hampshire and Vermont. One afternoon while driving through a famous ski resort near the Maine border, I came across an old-time surveyor who was doing some work just outside the village on a large, level tract suitable for development purposes and could not resist stopping to talk shop. He informed me that he was laying out a proposed subdivision of nearly two hundred lots to meet the ever-growing needs of his bustling community and that he was happy to get out of the woods where he had been working all summer. His project was a most interesting one, but the method that he was employing will spell trouble for some of the prospective lot owners. For interior subdivisional work, he was using his compass and chain, the former of the tripod type with a 3-inch needle. The client was probably getting his work done for what he considered a bargain price, but the grantees won't find it inexpensive when they start having resurveys made.

The Surveyor's Qualifications and Practices

Another factor contributing to future boundary disputes arises directly from the many instances in which resurveys for proposed subdivisional work have been based on incorrect evidence. Any experienced surveyor knows that he is not fully qualified to handle work of a responsible nature until he has acquired the knowledge and skill necessary for the recognition of all factors constituting good field practice and evidence plus the ability and judgment to evaluate them. Yet this necessary prerequisite is given scant attention in many places.

Unfortunately, certain persons both within and without the profession consider land surveying an easy job and a good spare-time proposition involving little

or no responsibility. These part-time practitioners are seldom qualified to handle work of a responsible nature, and for this reason they further complicate our metes-and-bounds picture.

There are good habits and bad habits, and our degree of success in life depends largely upon which get the upper hand. A couple of the worst habits of our profession that persist to the present time are fudging notes and failing to close traverses. The former is more than a habit, however, it is a piece of downright dishonesty, while the latter is a more or less subtle way of shirking responsibility. In one county in our section we can always be certain of obtaining incomplete plans or metes-and-bounds descriptions for the period shortly after the Civil War. The surveyor and his son who prepared them may have made a good living from fragmentary jobs back in their day, but they certainly left a bundle of headaches for posterity.

These comments are not prompted by malice aforethought or rancor but are merely factual examples of poor surveying practice and, as such, illustrate some of the factors which contribute to our jumbled metes-and-bounds problem.

The Public and the Client

During the past few years some of us have been trying to improve the status of land surveying from the public relations standpoint. A beginning has been made through interviews with clients, newspaper and magazine articles, and informal talks to civic groups and service clubs, using as our thesis the need for the cooperation and understanding of the public at large in order to introduce better methods and procedures for conveying property.

As a result of our efforts to date, it is becoming increasingly apparent that the public feels no sense of responsibility for its share of the blame with respect to faulty descriptions and poor conveyancing. In the main, the public is probably right, although this viewpoint is hard to justify when a client deliberately ignores or goes contrary to the advice of competent surveyors and attorneys. Most cases of this nature seem to fall into the simple category of penuriousness or apathy, although there are always people who will obstinately oppose any suggestion designed to benefit them.

One of the most common obstacles to good surveying practice is the client who refuses to permit either the time for a thorough investigation of his case or a survey commensurate with the limit of accuracy required for satisfactory work. Last fall we were called to a New Hampshire town to make a survey for a woman who had recently purchased a couple of acres of land (the deed said 4 acres, more or less) near the center of one of the better-known summer resorts. She purchased the land 2 years ago from a local real estate agent without benefit of survey or title examination, erected a $40,000 bungalow, and stocked it with valuable antiques. Subsequently she had a mild tiff with an elderly spinster who abutted her on the east concerning a right-of-way that the real estate owner had led her to believe was included with the deal. Her first question concerning the probable cost of the survey had a familiar ring; after that she proceeded to tell us how badly she needed to have her boundaries surveyed and how right she thought she was in claiming the occupational lines as true boundaries. Inasmuch as her present deed description consisted only of the customary references to past transfers, it was necessary to go to the county registry and examine the recording of past

conveyances. The method of procedure in this case was typical of many resurveys of this nature; in other words, it was absolutely necessary to protect the client by a careful examination of the evidence, both in the registery and the field. This we did, and in the meantime she left for her winter quarters in another state. As things turned out, we had good luck and were able to pin things down in her absence, saving her local embarrassment and possibly future litigation. By combining her job with other work in that locality, we were able to effect a tidy saving on overhead in her favor. Just as I was about to pass along the good news, a letter arrived at our office stating that she felt she could not afford to spend over $50 for the whole project, so would we please cancel everything. I wouldn't have felt quite so sour about the whole matter if it hadn't been for the fact that she was wintering in California at the time.

New England has its share of roads of all types, and, with the modern trend toward back-to-the-country living, many land tracts within commuting radius of the larger metropolitan areas are being subdivided into lots and small estates. Many of the town ways and some of the old county highways were never bounded, or were so poorly bounded and described as to offer no concrete evidence as to the original intent of the survey. In these instances, problems are constantly arising with respect to the frontages and depths of abutting tracts. Unless these tracts have sufficient remaining bounds or occupational lines to verify the fragmentary metes-and-bounds descriptions now available, it is extremely difficult to make a satisfactory resurvey of the land. Naturally, many disputes arise over these discrepancies, with the result that settlements, either through arbitration or through the courts, are required. We have always taken the attitude that arbitration backed up by a recorded form of agreement, or reciprocal quitclaim deeds supplemented by a recorded plan, are the preferable methods of settlement for cases of this nature. Responsible town and county officials are now beginning to see the light and are securing appropriations from public funds for the sole purpose of properly bounding and describing these forgotten highway limits so that future surveys of adjoining property will be referenced by these permanent lines. It is amazing, however, how some citizens resist even this bit of personal assistance, claiming that these takings constitute an encroachment on their land and on their rights as property owners.

The Surveyors' Sins

As we reach the concluding phase of this paper, I would like to mention one or two more factors which contribute to our metes-and-bounds problems. We must not overlook the practical and ethical problems which arise from withholding data: salting away in private files records of surveys that never come to light until it is too late to save clients unnecessary costs as well as embarrassment and confusion. This is a batch of dirty linen that we will have to wash among ourselves. We are also faced with another problem of our own making but not of our own choosing. Even in those rather uncommon instances during the performance of our work where all factors are optimum—such as a cooperative and understanding client, good working conditions, proper equipment, and a satisfactory closed survey in the field—we can and sometimes do foul up the office details by submitting incomplete and erroneous data on our plans and with our descriptions. We have all suffered from the past mistakes of others in this respect and, if we are not careful, may suffer from some of our own.

CONCLUSION

These are some of the problems relative to metes-and-bounds location in New England. It is obvious that conditions can and should be improved, and we are looking to this organization for assistance. It is both gratifying and reassuring to know that a group of men in this profession, representing all sections of the United States and foreign countries as well, are uniting under the splendid leadership of the officers of this Congress for the purpose of improving the standards and ethics of our profession. May we all wholeheartedly join in the worthwhile effort to elevate our work to a position of prominence and recognition comparable to other professions, securing not only for our clients but also for ourselves and our successors the right to do a good job and record it for posterity.

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New Map-Reproduction Device Announced

A SPIRIT DUPLICATOR, 22 by 29 inches in size, which is capable of producing large, multi-colored maps, map overlays, overprints, and miscellaneous sketches and diagrams, has been developed at the Engineer Research and Development Laboratories, Fort Belvoir, Va.

The Spirit Duplicator is expected to fill a long-felt military need for the reproduction of maps on short notice in the field, where lithographic reproduction is either impractical or unjustified. Besides its military applications, it can also be used commercially for the preparation of large charts, forms, and typewritten material.

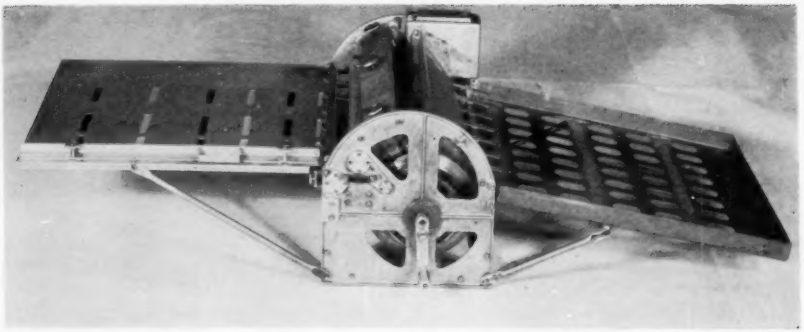
Hand operated and friction fed, the new Duplicator is a spirit-process-type machine which can print four colors on paper up to 22 by 29 inches in size. Special color carbons of purple, red, blue, and green are used in drafting a master copy, which is then placed on the machine's revolving drum. Paper is fed through spirit-dampened rollers before contacting the master copy under pressure and is then delivered to the receiving chute in finished form.

Maximum use of nonstrategic materials has been accomplished in the design of the Spirit Duplicator. It also provides maximum interchangeability of parts. The device has been operated satisfactorily under temperatures ranging from $+25°$ to $+130°$ F. Under normal operating conditions of 75° F., it has produced 200 copies of map overprints on high wet-strength map paper and 100 copies of map overlays on map overlay paper. The Duplicator is capable of an accuracy of register within 1/32 inch.

Lighter in weight and more readily portable than the old 22- by 33-inch Gelatin Duplicator which it replaces, the Spirit Duplicator, with accessory equipment, supplies, and carrying chests, weighs only 468 pounds. Packed in two chests and ready for shipment, it meets the dimensional and weight limitations for air transportability. Tie-down points are effected by means of chest handles.

The set is a complete operating unit and requires neither additional material nor special training of troops for its operation.

The primary difference between the new spirit and the old gelatin processes is the use in the Spirit Duplicator of alcohol as the dampening medium to transfer the image directly from the master copy onto the copy paper. The gelatin process uses water to moisten a gelatin pad, which is then impregnated by the image



NEW 22- BY 29-INCH SPIRIT DUPLICATOR

from the master copy and remoistened again each time to transfer the image from the pad onto copy paper.

Another difference is in the method of preparing the master copy. In the gelatin, inks or pencils are used and the image drawn directly onto the master paper, resulting in a positive image (reading from left to right). In the spirit process, a dye original negative (reading from right to left) is prepared by typing, writing, or drawing on a sheet of master paper backed by the Spirit-Duplicator-process carbon paper.

The two inherent weaknesses of the old gelatin process—difficulty of operation under varying climatic conditions and inadequacy to produce more than an average of 50 copies—have been eliminated in the new Spirit Duplicator. With these two problems solved, the job of producing maps in any future conflict will be facilitated considerably.

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Inadequate Mapping Handicaps Defense Effort

INADEQUATE TOPOGRAPHIC MAPPING of many parts of the country will handicap the national defense effort, Secretary of the Interior Oscar L. Chapman stated recently in announcing publication of two maps showing the status of Federal topographic mapping in the United States. Only about 10 percent of the country is now mapped to fully adequate standards, the status maps show, and another 15 percent is covered by maps which, although deficient in some respects, are still usable for most needs.

During World War II, lack of satisfactory maps hampered numerous defense activities, Secretary Chapman said. "Inadequate mapping increased the difficulties of making reconnaissance surveys in connection with location of military installations and war plants, retarded exploration for new mineral deposits, and in other ways slowed down the country's war effort," he added.

Adequate topographic maps cover all of Massachusetts, Rhode Island, and Puerto Rico, the status maps reveal. It is expected that Connecticut will be completely mapped by 1953 and Kentucky by 1955. In eight other states mapping has been completed, but a majority of quadrangles need revision.

Both status maps and a descriptive folder on the topographic map series are available without charge from the Map Information Office, U. S. Geological Survey, Washington 25, D. C.—*Civil Engineering,* November 1950.

What Should Surveying Instrument Specifications Contain?

By Dr. IRVINE C. GARDNER

CHIEF, OPTICAL INSTRUMENTS SECTION, NATIONAL BUREAU OF STANDARDS

BEFORE I start on my formal presentation, it might be well to tell exactly the process by which we prepare Federal specifications. In the first place, the Federal Specifications Board appoints a group of people drawn from the using services of the Government and such technical branches of the Government as may be able to supply technical information which is valuable in the formulation of the specifications.

A committee on surveying instruments contains from 12 to 15 people. When the specifications are to be prepared for a particular instrument, say, for a surveyor's transit, a subcommittee is appointed to draft a tentative set of specifications. These are then submitted to the general committee, which holds several meetings to revise and reform these specifications. After this stage has been reached, the specifications are forwarded directly to the Government using agencies and to a manufacturer for comments and criticisms. After these comments and criticisms have been returned, the Committee on Instruments meets again and tries to redraft the specifications to meet, so far as possible, the opinions and wishes of these several agencies and manufacturers. Then this specification goes again before the general committee for finer revision. If at that time the committee agrees that the specifications are in such form as to satisfactorily meet the demands of the different agencies, the specifications are promulgated. You can see that this is a very democratic process in which no one person is predominant. No one person is entirely satisfied with everything that comes out in the given set of specifications. However, we believe it is an excellent way to get a specification that is comprehensive, fair, and impartial.

In an attempt to understand the whys and wherefores of Federal specifications or to devise a philosophy underlying their formulation, it is necessary to keep in mind the purposes which the specifications are intended to serve. All questions that arise should be decided in the manner which will best further the purposes for which the specifications are being prepared. In my opinion the purposes of Federal specifications are twofold: (a) to ensure that the Government shall be able to purchase satisfactory materials, and (b) to allocate Government contracts to our manufacturers in an equitable and fair manner.

To meet the first purpose, the specifications must be sufficiently complete and precise to screen out all inferior materials. To meet the second purpose, the specifications, must be sufficiently general, without sacrifice of precision, to pass all commercial products which will prove satisfactory for Government use and to require no special modifications which may put certain manufacturers at a disadvantage without any compensating benefit to the Government.

WHAT SHOULD SPECIFICATIONS DESCRIBE?

Thus far we have dealt primarily in generalities, but it is a reasonable presumption that I was invited to appear before you on this subject because I happen

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to be chairman of the Committee of the Federal Specifications Board concerned with surveying instruments, and from now on specific questions or problems involving surveying instruments will be discussed in order to illustrate the types of questions that arise and the philosophy which underlies their resolution. The question that arises time and time again in the preparation of specifications is this: Should the specifications describe the instrument in detail or should they be limited to performance requirements, allowing each manufacturer to construct an instrument as he thinks best, consistent with the required performance? Two extreme cases will be cited in order to show that there is no single answer to this question.

Let it be assumed that the Coast and Geodetic Survey is conducting a very precise first-order triangulation requiring instruments that transcend those available on the open market for any commercial (as distinguished from Governmental) application. In the general course of events such an instrument of so limited application would have been developed at the expense of the Government, either in its own laboratories or by some manufacturer of surveying instruments. If such an instrument were to be purchased in quantity it would be justifiable to include complete working drawings as a part of the specifications to be submitted to any potential contractor, and if interchangeability were an advantage worth the additional costs tolerances might be set which would insure interchangeability of parts, even among instruments produced by different manufacturers. Performance requirements might also form a part of these specifications. A specification which tells in detail how to make an article is sometimes referred to as a cook-book specification, because it gives the complete formula for construction just as a cook book gives a recipe. This type of specification is easiest to prepare for an existing instrument. The principal disadvantage of such a specification is that the instruments cost more, because each manufacturer has to tool specially for the order.

The other extreme arises when the Government, for one reason or another, performs surveying similar in purpose and precision to usual commercial operations. For such surveying it may be anticipated that a number of makes of surveying instruments will be available which differ greatly in detail but are satisfactory for the designed use. In such a case it would be manifestly unfair to specify details of such character as to prevent some manufacturers from submitting their regular instruments and compel them to tool specially. Instead, it is desirable to specify the instrument entirely by performance characteristics, leaving to the manufacturer the opportunity to meet these requirements in the manner that he thinks most advantageous. This course preserves the competitive situation and in the long run results in improved instruments at lower cost not only to the Government but also to non-Governmental users.

The two instances that have been cited have been purposely chosen as extreme cases and the answers are easy. No one could dispute them. Unfortunately, however, there are difficulties. The problems that arise in practice are usually neither all white nor all black as in the preceding paragraphs, and when one attempts to prepare a specification that is precise and complete, it is difficult to confine the requirements entirely to performance.

SPECIFICATON FOR THE TRANSIT

For a specific example we shall now turn to the specification for the 1-minute transit, Federal Specification GG-T-621, dated December 1, 1948. This specification definitely presents a case in which commercial instruments should be accepted with the minimum of change and, consequently, the requirements should be based on performance. The principal detail requirements relate to performance under various ambient conditions: Overall accuracy, performance when ex-

posed to radiant heat, properties of the optical system, style of graduation, and characteristics of the level vials. Some of these items might be construed as descriptive rather than performance characteristics, but in such cases they are descriptions of fundamental properties and are assumed to be necessary for satisfactory performance.

The principal tests are based fundamentally on performance. There is, for example, the test by exposure to radiant heat. In this test a group of incandescent bulbs producing an irradiance substantially equivalent to that of the tropical sun is assembled and the instrument must function satisfactorily when subjected to this radiant heat for a period of 3 hours.

If the transit is provided with a magnetic compass the transit must be tested to determine whether it is sufficiently free from magnetic materials to give readings of horizontal angle which are not influenced by the relative position of the compass needle to either the rotating parts of the instrument or the fixed instrument base. There are two tests by which to measure the accuracy of angles, one for use in the laboratory and one for use in the field. In addition, there are tests of magnification, resolution, field of view, and diameter of exit pupil for the telescope, and tests for the sensitivity of the level vials. These are all performance tests. They are relatively easy to understand and are closely associated with the functional requirements of the transit. In most respects the tests are reasonably precise, yet sufficiently general, so that no manufacturer is placed at a disadvantage in supplying his stock instrument.

DURABILITY TESTS ARE DESIRABLE

Although the specification is satisfactory it is still not difficult to see ways in which it can be improved. For example, there is no test to determine the durability of an instrument. There are standard phrases such as "The materials used shall be first class in every particular; castings should be of virgin metals; bearings should be of recognized bearing properties; all parts of the instrument shall be designed, manufactured, and finished in a thoroughly workmanlike manner; minimum clearance in the bearings with optimum operating performance," etc. It is distinctly better to have these phrases included than to leave them out, but they still leave much to be desired. There are no tests specified nor tolerances given for these requirements, and an instrument would have to be very poor indeed before it could be rejected because of any of these requirements.

These phrases were inserted in order to assist the Government to secure instruments so well built that they will prove durable. What is really needed is a test which determines the durability of an instrument. It is characteristic of fine instrument work of any sort that of two instruments which appear to be of the same quality, one, by reason of better workmanship throughout, may actually cost much more than the other and may be worth the additional cost because of the longer life built into it. Due to the expense and time involved, it is not feasible to distinguish between these two instruments by taking them apart and studying the fit of all bearings and other characteristics of good workmanship. What is needed is an accelerated aging test.

The life of a transit may be expected to be 10 years or more. An accelerated aging test should require not more than 24 hours per instrument. It would be difficult to design a test in which the wear of 10 years could be produced in 1 day or less in a manner giving satisfactory correlation between the results of the test

and the wear and tear in the field. To plan such a test with hope of success would require great care; to build the apparatus required would be expensive; and then it would be necessary to apply the test over a considerable period of time and carefully analyze the failures before one could be confident of the usefulness of the results.

How would such a test be set up? Although there is no immediate probability of entering upon such an enterprise, it might be worked out something like this. One might have an apparatus that would maintain an oscillatory or to-and-fro motion in all movements of the instrument, including not only movements about the center and trunnions but also movements of the clamps, tangent screws, and other adjustments. During this period of movement there should be exposure to dust, moisture, change in ambient temperature, exposure to radiant heat, and shock. For an acceptance test the performance of the instrument after a prescribed program of this nature should be compared with the initial performance. If it were desired to study an instrument carefully and analyze its causes of failure, the changes in its performance at different steps of the aging test should be observed.

Undoubtedly much useful information concerning present types of surveying instruments could be learned from such a course of experimentation and, furthermore, the maintenance of such a laboratory would provide a means to study proposed improvements in instruments and determine their value. For example, the relative merits of the different types of trunnion bearings employed by the different manufacturers could be submitted to test. The possibility and advantages of the more general use of ball bearings in transits could be tested. I think the greatest advantage of the establishment of such equipment would be perhaps not the acceptance testing of instruments but rather the testing of new principles of design.

Another feature which I suspect could be added to the present specifications is a test to determine how well an instrument will maintain its adjustment. With an instrument of low precision, such as a 1-minute transit, there are so many adjustments provided that a relatively poor instrument may often be adjusted to give the required accuracy. How long will such an instrument stay in adjustment? It is evident that if the instrument is to be useful it must remain in adjustment for a considerable period of time when subjected to the ordinary hazards of field use. This obviously calls for a shock test of some type which the instrument should undergo without significant loss of adjustment. It is not difficult to write suitably precise specifications for a shock test, but it is difficult to be reasonably certain that the shock test correlates reasonably well with field hazards in order that the test may ensure satisfactory instruments. An instrument can become out of adjustment from exposure to intense solar radiation. Perhaps the radiation test should be extended to include tests of permanence of adjustment as affected by exposure to solar radiation or its equivalent.

EVALUATING THE TESTING PROGRAM

I hope what has been said will give you a better insight into the difficulties of writing good specifications. Much more is involved than assembling a group of experts in a room and telling them that they will not be released until a specification is completed. This procedure can work out only if the subject of the speci-

fication is completely engineered; that is, only if engineering study has been thoroughly applied to all questions connected with the design and functioning of the instrument to be specified. The telephone hand set and the automobile are examples of American products which have been engineered. Any given manufacturer has built surveying instruments in relatively small quantities as compared with the telephone or automobile. Therefore, surveying instruments do not make complete engineering economically possible, and for this reason the writing of perfect or near perfect specifications becomes a costly research problem.

In addition to the economics of manufacturing, the economics of a testing program is important in the preparation of specifications. There is a tendency to believe that the cost of tests should bear a direct relation to the initial cost of the instrument. Too great a discrepancy beween these two costs is always scrutinized with a critical eye, but the relation is not the direct one that is sometimes assumed. The cost of the instrument and the test combined should be compared to the value of the service rendered. An interesting example occurs in airplane mapping. To justify mapping by airplane the value of the service performed must be greater than the expenditure for the photographic work, the cost of the ground control, the cost of the airplane flights, the cost of the interpretation of the photographs, and the cost of compiling the maps. In comparison with this total, the cost of the camera equipment and its testing is quite insignificant, yet the success of the entire project depends upon it. Consequently, the efficiency of an entire operation may gain by an increase in expenditure on lens equipment or precision of testing which is large enough to be of importance to the lens manufacturer or the testing agency but entirely insignificant to the final cost of the project. In such a case, the manufacturer usually realizes the importance of his project and assumes greater responsibility in producing his article, which results in increased cost and, in turn, lessens the expense of the required tests. It is this type of interaction between the manufacturer and the testing agency and not any fundamental relation that tends to decrease the ratio between the cost of a test and the cost of the article tested.

Two devices have been regularly used to decrease the cost of testing. Of these the first to be considered is type testing. Some performance characteristics are largely the result of design and may be expected to remain constant for all instruments of a given type of manufacture. Such characteristics may be tested on one or more representative instruments of a given make and design to determine the general suitability of the instrument. Similar testing need not then be repeated on subsequent instruments of the same type or repeated only at long intervals to make certain that the original standard of performance is being maintained.

Another method of reducing the cost of tests is the application of a sampling process in which a representative number of the instruments are tested and, if found satisfactory, the entire lot is passed. The efficiency of this testing procedure depends upon the degree of control of a product that is maintained by the manufacturer. As the volume of production of a given item increases it becomes advantageous to the manufacturer to exercise more perfect statistical control of his product and it becomes possible to restrict the testing to a smaller portion of a given lot of items. Unfortunately, surveyor's instruments are produced in relatively small lots, usually not exceeding two or three hundred at a time, and a relatively large portion would have to be tested to obtain representative values of performance. Also, in peacetime only a few instruments are

usually bought at a time and, consequently, a sampling process does not appear to be particularly applicable.

At the beginning of this discussion it has been stated that the purposes of a Federal specification are the assurance that the Government shall receive materials and equipment of acceptable quality and that the contracts for the requirements of the Government may be allocated fairly to our manufacturers. Incidental to the achievement of these purposes, specifications confer other benefits. Complete specifications for an instrument as complicated as a surveyor's transit are a valuable source of information in that they present in concise form a complete discussion of the performance requirements of the instrument and a description of the methods of test. In the current set of specifications it has been considered desirable, when possible, to present two methods of test: one suitable for application in the testing laboratory and one for application to send an instrument into the central laboratory for testing.

Well-prepared specifications will in general lead to the improvement of the product described. The level of performance set by the specifications is determined by the requirements in the field. When commercial instruments are available, as in the case of the 1-minute transit, it is not to be expected that all makes will meet these requirements equally well. The codification of the requirements and the provision of objective methods for testing facilitate the comparison of the different instruments in purchases not only by the Government but also by large commercial firms which may use Government specifications. The objective comparisons of the instruments, one with another, acts as an important incentive to induce the manufacturers to improve their product.

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Forty-Fourth Annual Meeting, Canadian Institute of Surveying and Photogrammetry

THE FORTY-FOURTH ANNUAL MEETING of the Canadian Institute of Surveying and Photogrammetry was held in Ottawa on February 8 and 9, 1951. Approximately 300 members and guests attended the 2-day session. Visitors from the United States included Talbert Abrams, President, American Society of Photogrammetry, Virgil Kauffman and A. O. Quinn of Aero Service Corporation, P. G. McCurdy, and your President.

The meetings were well conducted under the able chairmanship of President W. Humphreys and consisted of only one or two papers each half day, with discussions. From the standpoint of general interest, the paper "Surveying and Mapping in the Union of South Africa" was unusually good. Prof. K. B. Jackson's startling demonstration of stereoscopy also high lighted the program.

A program luncheon was held the first day, attended by practically everyone at the meeting as well as many visitors, including the American Ambassador. The traditional stag dinner was held that evening and was attended by about 30 members and guests.

The exhibits, though small in number, were well arranged. They included an elaborate display of modern train transportation by the Canadian National Railroad and various kinds of new surveying and photogrammetric instruments of both American and British manufacture.

The 30° below zero weather was more than compensated for by a stimulating program and the warm hospitality of our Canadian friends.

—GERALD FITZGERALD

Molded Plastic Relief Maps and Aerial Photographs

By C. S. SPOONER, JR.

CHIEF, RELIEF MAP DIVISION, ARMY MAP SERVICE

THE uses and acceptance of topographic models have increased greatly since the war, largely because of the drastic reductions in production costs that have been realized in this specialized field of cartography. Prior to and during the war most reproductions were prepared by long hours of tedious hand painting, and original models were generally inaccurate because of inadequate tools and dimensional instability of the materials used in model production. Since the termination of hostilities, the Army Map Service has conducted intensive studies of all phases of model production in an effort to render three-dimensional mapping a practical speciality. Such effort has culminated into current practices that have reduced model construction costs by approximately 30 percent and model reproduction costs by approximately 90 percent. In addition to this economy, the accuracy of original models has improved greatly. This paper presents the major refinements accomplished to date.

The absence of proper three-dimensional mapping tools was most critically felt in the construction phases. Jigsaws and Cutawl machines, used to cut laminae representing each contour interval, proved inadequate, for considerable human error occurred while guiding the cutting blades of these machines through the individual sheets. Cardboard, the most commonly used laminate material, furthermore, proved to be highly unstable because of varying humidities. With normal reflecting projectors, map line material could not be transferred onto the model surface without image distortion due to the relief.. Therefore, accurate editing, or production control, at various stages of production was not possible.

Critical comparisons of model construction tools, including jigsaws, Cutawls, the Reliefograph, and three-dimensional pantographs, proved a pantograph of German origin to be mechanically superior (fig. 1). Attention has been placed on redesigning this instrument. The current practice is as follows: a glass contact plate of the contour drawing is prepared from which a deep-etch zinc plate is procured by photoengraving processes; the zinc plate is positioned on the table at the right side of the pantograph. The blunt stylus of the original German machine is replaced by a phonograph needle. The operator guides the needle along the etched contour lines of the zinc plate with facility and the possibility of human error is greatly reduced.

The model base used by the Germans was a solid block of plaster. This necessitated routing out excess plaster outside the contour line as successive contours were cut. This base has been replaced by a laminated plastic block, each plastic sheet representing the height of the contour interval. The fabrication of these laminated blocks is accomplished by spraying each plastic sheet with a pressure-sensitive adhesive and subjecting the assembled sheets to approximately 300 p. s. i. The finished laminated block is then positioned on the left hand table

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of the pantograph. The cutting head of the pantograph contains a high-speed drill which can be raised or lowered to cut at different elevations. The operator positions the cutter to cut through one laminate and traces the contour pattern of this elevation on the etched plate. When tracing and cutting is completed for this elevation, excess plastic, or material falling outside of the contour line, is manually stripped from the block and discarded. This procedure is repeated, lowering the cutting head for each successive cut. The resulting stepped contour terrain base is then ready for edit and modeling. An approximate 72 percent saving of man hours for terrain base construction is afforded by this procedure.

A second refinement has been the development, at the Army Map Service, of a special projector in order that rigid production control can be maintained throughout production. This instrument is termed the Shadow Projector (fig. 2), and employs the telecentric optical system. It consists of two parts: light source and objective lens. Only parallel rays of light pass through the objective lens. The glass plate of the contour lines (used for preparing the etched zinc plate as previously explained) can, therefore, be positioned over the model, and shadows of these lines are cast perpendicularly to the datum of the model regardless of the amount of relief encountered. Although the aperture of the lens in this case is only 9 inches, complete scanning of the model under this system is possible, since the glass plate and model are contained in the cradle which can be moved at will to bring any portion of the model within the collimated

FIGURE 1.—Three-dimensional German pantograph. Note the tracing stylus (*A*), cutting drill (*B*), and the mechanism for raising and lowering the cutting head (*C*).

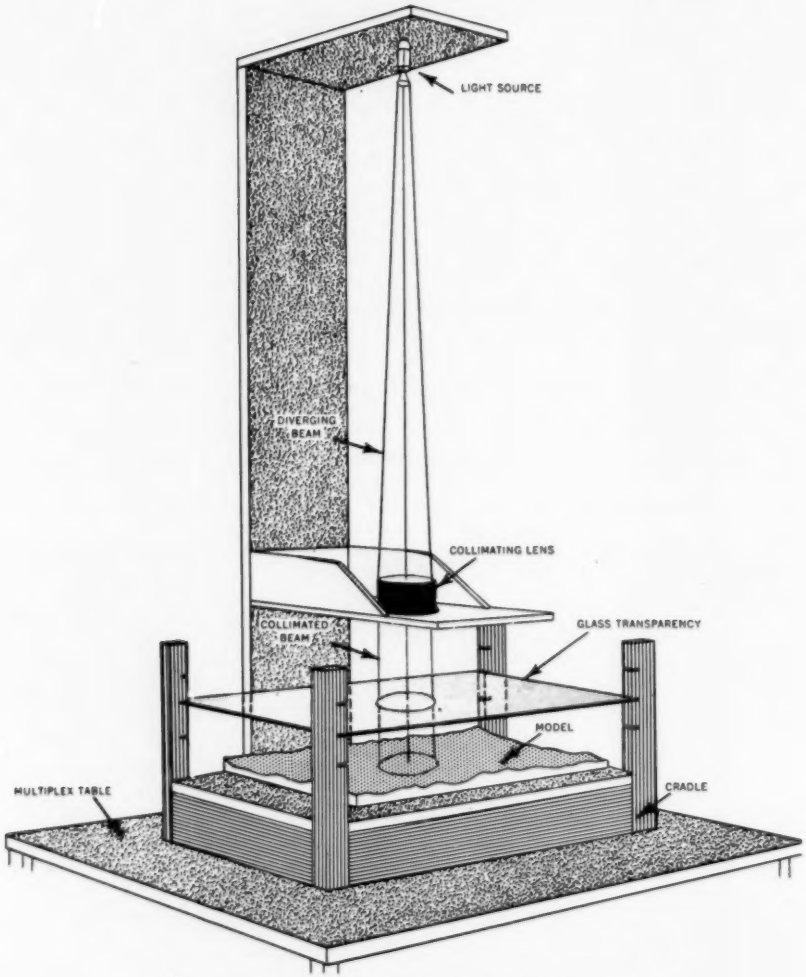


FIGURE 2.—Schematic view of the Shadow Projector.

beam. This instrument is used not only for checking the accuracy of the terrain base cut on the pantograph, but also for details of modeling, scale fidelity in subsequent castings for production molds, and accuracy of reproductions. Production control, therefore, is practical for every step of the assembly.

Conventional casting plasters cannot be used for the preparation of file negatives and production molds because of the excessive expansion that occurs upon cure. The accuracy of the original model need not be lost in subsequent casting, however, if such casting materials as Hydrocal B-11 plaster or oxichloride cements are used.

More drastic reductions in cost have been realized in the reproduction aspects of model production. Instead of $25 to $50 per square foot for hand painting model copies, models can now be reproduced for as low as $1.00 per square foot. This has been possible by the post-forming of printed plastic sheets. This process was originated by Mr. John Braund, of the Coast and Geodetic Survey, and has been used for a number of years by Aero Service Corporation of Philadelphia, Pa. (fig. 3). The process is basically as follows: Color plates of standard flat maps are used to print, by rotary or flat bed presses, vinyl plastic sheets. A printed sheet is registered over the positive mold of the model, with an especially designed vacuum and cooling system incorporated into the mold. The sheet is then heated to approximately 250° F., at which time full vacuum is applied. The sheet is instantly formed over the developed surface of the mold, then removed and trimmed. The entire cycle is from 2 to 4 minutes per molding. This is the finished product and bears identical information as the standard flat map series. The essential advantages of the process are, therefore, that special map manuscripts do not have to be prepared for model production and no hand painting is required. This permits the economic integration of relief map production with mapping activities.

The Army Map Service has endeavored to improve the molding quality of the plastic sheets. A fundamental refinement has been the forming over positive rather than into negative production molds. Forming into negative molds, peaks and valleys are the last features formed. As a consequence, the plastic material is thinned appreciably at peaks and crestlines, printing is distorted, and frequently the plastic will not draw to the full demand of the mold so relative heights are not preserved. In positive forming, the peaks and crestlines are the the first features formed and the objections just mentioned do not occur. In exceptionally rough terrain, however, valleys may not fully form if positive forming is used.

It is acknowledged impossible to heat-form a flat printed plastic sheet and obtain precise registration of all map detail on the surface of the model. However, if the original model is accurate and size is maintained during the casting of production molds, 90 percent of all points on an average molding should fall with plus or minus 0.02″ of correct position; this is quite adequate for most map uses.

To provide a more lasting product, it has been the practice of the Army Map Service to use transparent vinyl sheets and to print in reverse. Final moldings, therefore, carry the inks on the underneath surface and the user can write and erase annotations on the surface of the model without damage to the printing inks.

For small-scale products, a 90° bend is executed at the neatlines of the models and a second plastic sheet, or preform, is formed with reinforcing ribs in order to support the top molding. This eliminates center sag within the model and permits the butting of several panels to form regional coverage.

The summation of these construction and reproduction refinements is perhaps best illustrated by the Army Map Service current production capacity of from 15,000 to 20,000 plastic reproductions annually, the latter being in excess of the total of all model reproductions produced by all allied model activities in the last war.

Thus far this paper has dealt with the quantity production of plastic relief maps. Instances arise, however, where map manuscripts do not exist or pro-

ducing groups do not have ready access to such material. Such would be the case of military field units operating in forward areas. The basic source material under such circumstances would, in all probability, be aerial photographs. In order to meet model requirements for such cases, the Army Map Service has

FIGURE 3.—The vacuum molding machine, showing the radiant-type heater (*A*), positive production mold (*B*), quick-action globe valve for vacuum (*C*), hand control air valve for raising table (*D*), and the pneumatic cylinder for raising the table (*E*).

advanced a technique of rapidly producing molded plastic continuous or halftone aerial prints, complete with any desired annotations.

If contour information is not available, and elapsed time requirements are stringent, formlines approximating the contours are drawn while inspecting overlapping stereopairs under field stereoscopes. Time permitting, more accurate contour data can be prepared by employing the conventional stereoplotting devices. For expediency, errors in the aerial print due to tip and tilt are not corrected. A superior product will result, of course, if rectification can be scheduled. The contours for the aerial print, however compiled, are drafted on a transparent material such as vinyl, a second copy being prepared for contour cutting. Onto this contour base is also written or drafted the annotations required to emphasize terrain or cultural features. The contour base, with annotations, is registered with the negative of the aerial print and a composite is prepared photographically.

The original model is prepared by conventional means depending upon the time alloted for production. Cardboard laminae, cut by Cutawls and modeled in clay, is probably the most rapid means for so small an area. More refined measures such as utilization of the pantograph or actually carving the relief under multiplex projectors will result in much more accurate compilation of the original model.

Upon completion of the original model, a library mold is cast in stable B-11 plaster. Whereas production molds for relief maps require 40–80 man hours, such would be impractical for field units. To meet this problem, a metal casting plaster known as PMC and produced by the U. S. Gypsum Company is used. This medium, upon proper cure, is very porous, and does not require an elaborate vacuum system. These PMC molds can be prepared within 4–6 hours. Mold fragility is a less desirable feature of the material but, with care, a mold should last for 25–50 moldings. Duplicate molds can be cast if more copies are required, or permanent molds can be prepared in oxichloride cements.

While the original model is being prepared and production molds are being cast, the processing of the required number of plastic prints for subsequent forming can progress simultaneously. Four methods have been developed for the preparation of the plastic prints: namely, dry ammonia processes; photographic means; photo-mechanical methods; and photo-lithographic procedures.

Through the cooperation of the Ozalid Division of the General Aniline and Film Corporation, 0.015-inch transparent vinyl sheets have been coated with diazo dyes. This stock, when placed in contact with a film positive of the contours and annotations, produces a plastic continuous-tone print within 4–6 minutes when processed through an Ozalid machine. High image resolution has not yet been obtained, however, and this method must still be considered experimental.

Prints of high quality have been prepared photographically on vinyl sheets coated with Convira #2 emulsion as supplied by the Ansco Division of General Aniline and Film Corporation. This is a standard contact photographic process utilizing the composite negative of the aerial print, contours, and annotations. Prior to heat-forming, however, the emulsion must be sprayed with ethylene glycol or the emulsion will crack and otherwise deteriorate during the forming cycle.

A third means of providing the plastic prints is the photo-mechanical technique known as the Gum Reversal Process. This is described in detail in Army

Map Service Technical Bulletin No. 3. Utilizing Black Beauty dyes, as perfected by the Army Map Service, 200-line halftone prints are made. The dyes are not affected by the heat of forming.

A fourth means is standard photo-lithographic procedures used for printing 200-line halftone prints. No great difficulty is experienced in printing the image on rotary printing presses, as long as the vinyl stock is not thicker than 0.015-inch. This method is the most economical if large runs are required.

Upon completion of the preparation of the requisite number of plastic prints, they are positioned over the PMC positive mold and formed in the same manner explained for plastic relief maps. About 50 moldings an hour can be produced.

This technique enables a crew of four to construct an original model of an average 9- by 9-inch aerial print and provides 25–50 continuous or halftone molded plastic copies within 48 to 72 hours. Approximately 500 square feet of floor space is required for all processes.

In addition to the tactical use of such products by the military, the molded aerial photograph should prove popular with civilian agencies concerned with land management problems, land development studies, highway site selection, city planning, civil aviation activities, etc.

The refinements presented have been successful in evolving relief or three-dimensional mapping from the status of an uneconomical and time-consuming speciality to a practical one.

Current development studies at the Army Map Service pertain to new uses of the three-dimensional maps. One such project deals with the preparation of shadow relief plates for the subsequent overprinting of standard planimetric information. This is done by orthographic photography of models and promises to be a more accurate procedure than air-brush renditions of relief shading.

A second project deals with a fundamentally new use: the preparation of orthographic or parallel oblique views of models accomplished through orthographic photography. Such products retain the rectangular coordinate qualities of the flat map, thus permitting ready reference to the flat map—a vast improvement over normal perspective oblique views.

In summary, the Army Map Service has scrutinized, altered, or refined practically all phases of relief map construction, reproduction, and product end use, and such revolution is leading to the successful integration of this speciality with conventional mapping programs.

* * *

THE WISDOM OF HERBERT SPENCER

Nearly 100 years ago the British philosopher Herbert Spencer wrote:

"A reader has only a limited amount of attention to give to what he is reading. Hence, if undue attention is consumed in unraveling the writer's language, there is that much less attention left to give to the subject matter. Difficult and exasperating sentence structure may exhaust the reader's patience so that he is prejudiced against the ideas so clumsily expressed."

Factors in Surveying Accuracies

By S. A. BAUER
REGISTERED CIVIL ENGINEER AND SURVEYOR, CLEVELAND, OHIO

THE PROPERTY SURVEYS DIVISION, since its inception, has been deeply concerned with the education of the property surveyor. In 1948 a project was outlined to attempt the preparation of an index for a textbook or handbook specifically for the use of the practicing property surveyor. With all due respect to the many excellent textbooks that now exist on surveying matters, none is directed at, or particularly suited to, the specialized needs of the property surveyor.

Good textbooks are not compiled overnight, and the problem of developing even an index for a property surveyor's handbook is a very complicated one. It is the hope of the Division that, through publication of articles on problems of property surveyors in SURVEYING AND MAPPING, and discussions resulting therefrom, sufficient material will be developed to form the nucleus of such a handbook. It is with this in mind that the following discussion relating to factors in surveying accuracies is presented.

Little of the information contained herein is of original thought. Most of it is available in a perusal of several texts. This discussion differs only in that it applies certain well-known theoretical information to the specific problems of the property surveyor, after passing that theoretical information through the fine mesh of the screen of economic limitations forced upon the profession by the many external forces that surround it. This discussion has been intentionally kept in simple terms, and in short, rather angular language, in order to expedite ready reference.

Further, this discussion is considered for use in conjunction with, and in order to obtain the minimum accuracies indicated by, the TECHNICAL STANDARDS FOR PROPERTY SURVEYS of the American Congress on Surveying and Mapping. Since a basic knowledge of the nature of observational error is necessary for the attainment of consistent and fairly high degrees of accuracy, a study of what might be called the anatomy of error is of value.

No observation, whether angular or linear, can be made with absolute precision. All observations contain some error. There are two general types of observational error: accumulating and compensating.

Accumulating errors are generally more or less uniform in amount within the same series of observations, and are always either positive or negative within the same series.

Compensating errors may vary considerably in amount within the series, and are as apt to be positive as negative within the same series.

The total effect of an accumulating error in a series of observations is expressed by the formula: $E_a = e_a$ times n, where E_a is the total of the accumulating error, e_a is the mean unit error, and n is the the number of repetitions of the mean unit error.

The total effect of a compensating error in a series of observations can be expressed only as a probability, and follows the formula: $E_c = e_c\sqrt{n}$, in which E_c is the probable total of the compensating error, e_c is the mean unit value of the compensating error, and n is the number of repetitions of the unit error.

The total effect of several different accumulating errors within a series of observations follows the formula: $E_{sa} = \pm E_{1a} \pm E_{2a} \pm E_{3a}, \ldots$ where E_{sa} is the total of all accumulating errors in the series, and E_{1a}, E_{2a}, and E_{3a} are the several total individual accumulating errors, with their proper value as positive or negative.

The total effect of several different compensating errors within a series of observations follows the formula: $E_{sc} = \pm \sqrt{E_{1c} + E_{2c}^2 + E_{3c}}, \ldots$ where E_{sc} is the total effect of all compensating errors within a series of observations, and E_{1c}, E_{2c}, and E_{3c} are the several total individual compensating errors.

In a traverse closure there are both linear and angular observations, both of which are subject to several compensating and several accumulating errors.

Theory and practice indicate that, under average conditions and with careful procedures, the total probable error created by the combination of linear and angular errors is expressed by the formula: $E_T = \pm\sqrt{E_A^2 + E_L^2}$, in which E_A is the probable error in angular observations, and E_L is the probable error of linear observations.

The above is in accordance with the law of probabilities. (This formula, however, does not hold where the accumulating errors are in amount so much greater than the compensating errors that the compensating errors lose significance.)

The theoretical probability curve as shown in the accompanying graph indicates that, for any particular precision repeated a sufficient number of times to insure true probability, closures of double the true accuracy will appear about 26 percent of the time, while closures of one-half the true accuracy will appear about 18 percent of the time.

The above indicates that the error of closure of any single or any small number of traverses is of little significance in determining the true accuracy of the observations, and only a large number of similar sets of observations (about 30) form a dependable measure of working accuracy. .

In practice, a large number of reruns of a particular traverse is economically impossible. Therefore, surveying specifications, to assure a specific accuracy, must have the allowable error of closure augmented by specifications of equipment and procedure, which extensive experimentation and repetition have indicated will produce a particular accuracy.

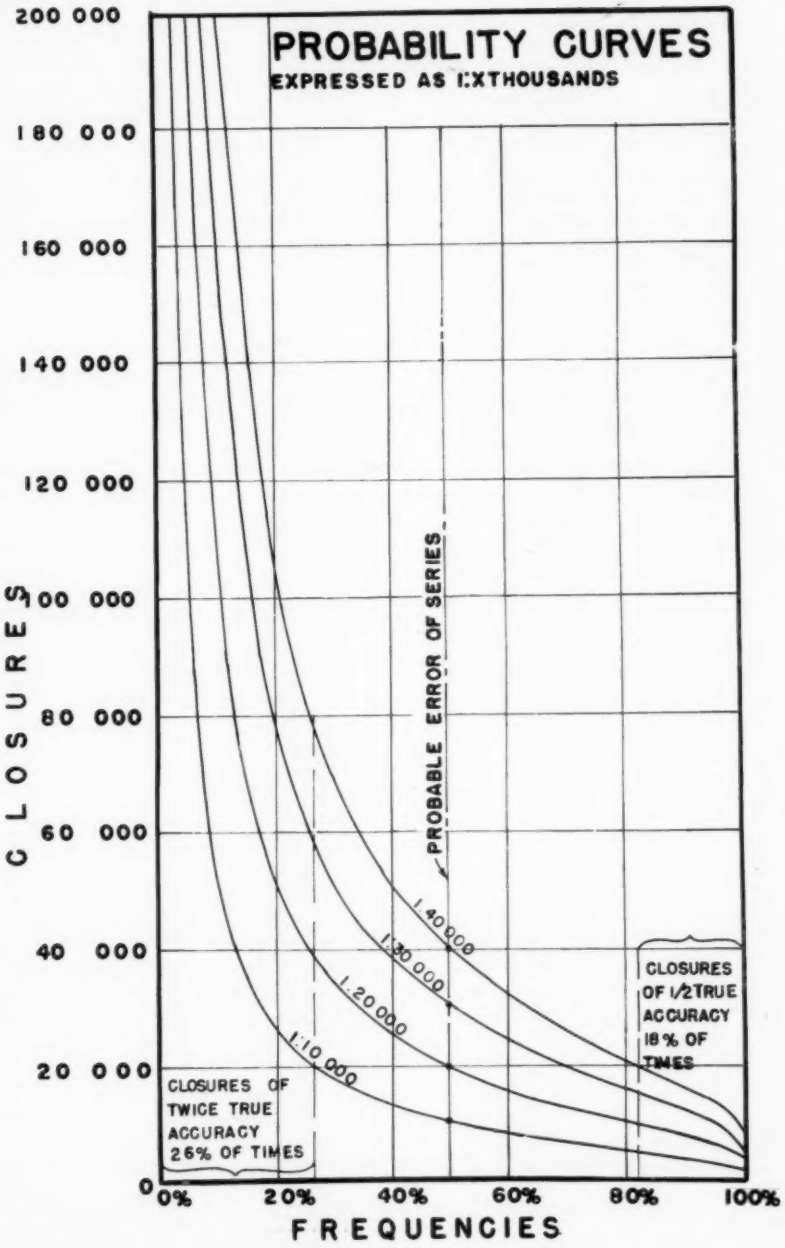
For these purposes there are two types of traverse: "Loop" closures, which close upon the point of beginning; and "Position" closures, which run from one fixed and known point to another fixed and known point.

In loop closures, the observed error of closure can indicate only consistency of work, since the accumulating errors for the main part, do not appear (only the *variation* of accumulating errors is indicated in loop closure).

Position closures, assuming the accuracy of the known termini, can indicate true accuracy, since all errors appear in closure (subject to compensation of error) and will therefore generally be reflected by a higher calculated error of closure than the same observational technique in loop closures.

Specifications for closure, therefore, must differentiate between the types of traverse involved.

The detailed ramifications of the above facts are endless. It is our experience that the nature of property surveying in a metropolitan area is such that the length of the shortest side of the traverse has more to do with the ultimate error


PROBABILITY CURVES
EXPRESSED AS 1:XTHOUSANDS
200 000
180 000
160 000
140 000
120 000
100 000
80 000
60 000
40 000
20 000
0
CLOSURES
PROBABLE ERROR OF SERIES
1:40 000
1:30 000
1:20 000
1:10 000
CLOSURES OF TWICE TRUE ACCURACY 26% OF TIMES
CLOSURES OF 1/2 TRUE ACCURACY 18% OF TIMES
0%
20%
40%
60%
80%
100%
FREQUENCIES

of closure than the length of the traverse. In theory alone, the length of traverse should be the determining factor, other things being equal, in the error of closure. It is probable that the limitations of property surveying are such that the maximum attainable accuracy is reached in a fixed distance, determined in a large measure by the length of the side, rather than the over-all length of the traverse.

The writer has been unable to apply any mathematical approach to the problem of the adjustment of several interlocking loop curves. The only solution found that does not invalidate itself is that of adjusting first the loop having the greatest error of closure, fixing the points of the traverse by that adjustment (the compass rule), and then proceeding through the various loops in the reverse order of their apparent accuracy. This method tends to increase the resulting error of closure of each subsequently adjusted loop, but in no case should reduce the accuracy below that of the least accurate loop. It is assumed, of course, that all of the loops be performed with uniform procedures, and that all closures be better than the accepted minimum standard.

A full understanding of the above basic facts will tend to increase precision, in that a knowledge of the relative importance of the various types of error is necessary for consistent accuracies of high precision.

The above facts also point the way towards the compilation of more workable specifications, for the attainment of specific accuracies, than generally appear. It is among the projects of the Property Surveys Division to compile such a set of specifications of instrumentation and procedure, that will assure the accuracies called for in the TECHNICAL STANDARDS FOR PROPERTY SURVEYS.

* * *

Massachusetts Land Court Recognizes ACSM

OFFICIAL, LEGAL RECOGNITION of the TECHNICAL STANDARDS FOR PROPERTY SURVEYS, drawn up and approved by the American Congress on Surveying and Mapping, has been accorded by the Land Court of the Commonwealth of Massachusetts. This is brought to the attention of SURVEYING AND MAPPING through a communication from William T. Fairclough, who is Engineer for the Land Court and an enthusiastic member of the Congress.

Mr. Fairclough reports that the "Manual of Instructions for the Survey of Lands and Preparation of Plans to be Filed in the Land Court of the Commonwealth of Massachusetts" was approved by Judge John E. Fenton, of the Land Court, in Boston on June 1, 1950. This Manual was issued for the information and guidance of engineers and surveyors making surveys and plans to be filed in the Massachusetts Land Court and supersedes all previous instructions issued by the Court. On page 3 of the Manual, which was prepared by ACSM member Fairclough, Item (7) under Section II, *Surveys*, reads as follows:

> "It is recommended that, as far as practicable, the field work be executed in accordance with 'The TECHNICAL STANDARDS FOR PROPERTY SURVEYS' adopted by the American Congress on Surveying and Mapping. Copies (of the STANDARDS) are available on request to the Acting Secretary, Box 470, Benjamin Franklin Station, Washington 4, D. C."

So far as is known, this is the first recognition by a court of the authority of the CONGRESS in the field of survey and mapping.

International Cooperation in Mapping Latin America

By WALTER G. STONEMAN

CHIEF OF LIAISON, INTER-AMERICAN GEODETIC SURVEY

SINCE 1928, the Pan American Institute of Geography and History, especially its Commission on Cartography created in 1941, has been active in promoting standardized and improved mapping and surveying throughout the Americas. The 1946 Pan American Consultation on Cartography in Caracas, Venezuela, served as a kick-off point for an action program by the Inter-American Geodetic Survey to implement these objectives.

A number of the Pan American Institute of Geography and History representatives who are key men in the Inter-American Geodetic Survey collaborative program are also active members of the American Congress on Surveying and Mapping. You can readily see how the three organizations fit together.

The Inter-American Geodetic Survey is a predominately civilian organization working on the mapping and charting program of the Caribbean Command, Department of Defense, directed by Col. Frank A. Pettit of the Corps of Engineers. It is concerned primarily with establishing ground control, and with assisting later in map compilation and reproduction. The Army Map Service supports it closely from the United States; the U. S. Air Force and Navy provide assistance in aerial photography and hydrography; and the U. S. Coast and Geodetic Survey is especially helpful in furnishing technical support and in lending personnel.

The United States is concerned with the actual performance of only limited portions of the total program. Its role, under the terms of a series of bilateral arrangements, embraces international coordination, technical consultation, training, and the furnishing of critical equipment.

Most of the work is done by the collaborating Latin American nations. In effect, this program welds into one coordinated hemispheric program the separate national mapping programs and facilities of all the countries involved. High tribute is due the fine gentlemen and neighbors from the collaborating countries who have contributed so much to this hemispheric program. The results are mutually beneficial—individually and internationally.

The operations are scattered over an area 3,000 miles wide and 6,000 miles long, several times the size of the United States. This area includes some of the densest jungle with steaming forests, the highest mountains with their volcanoes and high Andean glaciers, the driest desert, and contrasting palatial Copacabana Beach of Rio de Janeiro and the luxurious National Hotel of Havana.

NEED FOR A MAPPING PROGRAM

Why is this program needed? I will cite a few reasons from a cartographer's point of view.

A short distance from the Panama Canal is the beginning of a 100-mile-long range of mountains which rise to more than 5,000 feet. These mountains are

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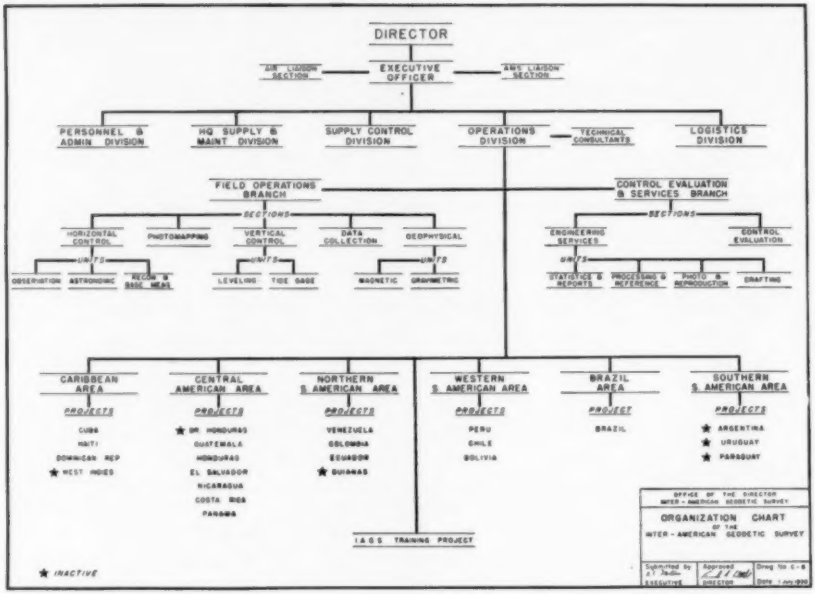


not shown on existing maps. At the far end, the maps show a large, nonexistent lagoon where there are actually 2,000-foot peaks. Only recently were these features added to the aeronautical charts.

Part of the Atlantic Coast of the Republic of Panama is compiled from British Admiralty charts, dated 1854.

In Costa Rica, a pilot obligingly flew me over a peak charted at 4,500 feet which we barely cleared at 9,500.

Our geodetic reconnaissance information alone has caused several aeronautical charts to be declared "hazardous." Pico Trujillo in the Dominican Republic is being moved over about 35 miles and raised 2,000 feet in elevation. It appears that part of the huge Xingu River in Brazil may be 30 to 40 miles from its true position on our aeronautical charts and maps.

Plotting the completed geodetic nets on existing maps reveals some amazing errors. The coastline shown on the existing Costa Rican map had to be moved over several miles so the geodetic stations would not be plotted into the Pacific Ocean. In Cuba, some stations have proven to be as far as 6 kilometers from their large-scale map positions and, in one case, on the wrong side of a town, a road, and a railroad.

A recent astronomical observation indicates that the Isle of Pines, just south of Cuba, may be nearly 18 miles out of position. This is a serious discrepancy, as the island is used as a check point by aircraft approaching the Havana airport.

In Eastern Peru, a large river is out of position by 10 miles.

A nearby map sheet shows a 75-mile area labeled "unsurveyed," and there are many thousands of square miles for which maps of even this quality do not exist.

Gravimetric Surveys Needed

As many people have implied, we really do not know which way is up. Unfortunately, the force of gravity as defined by Newton's old law does not always result in a pull straight down, because of density differentials within underlying geological formations or the existence of mountain masses to one side. Therefore, an intensive gravimetric survey is being planned around the point of origin for the South American datum in order to adjust this deflection of the vertical.

The relative position on the earth's surface of this point of origin, to which all points on the continent of South America are to be referenced, otherwise initially depends on a latitude and longitude value established by a precise astronomic observation. However, because of the gravitational deflection, the level bubble used in the astronomic instrument may not be exactly level with reference to the spheroid. Consequently, the gravimetric anomaly of this point must be determined before its true latitude and longitude can be assured.

Gravity surveys are also of significance elsewhere. For instance, in Chile, in the few miles from the top of the Andes to the bottom of the ocean deeps just offshore there is a total elevation change of 46,000 feet. If there is any area where the vertical may be deflected toward a mountain mass, this would certainly appear to be a classic example. Consequently, the Chileans cannot be sure that they actually are where the present surveys and maps show them to be on the face of the earth.

COMPLETED OPERATIONS

During the fiscal year 1950 we have established some 425 first-order triangulation stations; measured 31 base lines; done 8,500 kilometers of first-order leveling; installed 6 new tide gages, and maintained 51 in operation; established 37 astronomical and 60 magnetic stations; and accomplished some initial work in setting up a gravimetric program. This work has resulted, among other things, in the closing of a continuous 1,700-mile arc of first-order triangulation through

COMPLETED AND PROJECTED FIRST AND SECOND ORDER GEODETIC TRIANGULATION IN MEXICO AND CARIBBEAN AREA
LEGEND
Completed Triangulation
Projected Triangulation
Tide Gages

Central America, from Tapachula, Mexico, to Monteria, Colombia, through some of the most difficult jungle and mountainous terrain in the Western Hemisphere. Within the last few days a first-order arc was completed for the entire length of the island of Cuba. A good portion of the South American work is also completed.

First-order triangulation has been completed in several of the smaller countries. This means that their respective national cartographic programs may now continue apace to meet their own immediate national interests and at the same time be an integral part of the over-all hemispheric system.

This progress does not indicate where most of the heart-breaking man-years have been expended: the reconnaissance and station preparation in advance of the triangulation observations, and the logistical and administrative work required for these far-flung international endeavors.

The progress cannot be compared to stateside operations where road nets, weather, terrain, language, and political conditions are more favorable. Here in the United States one seldom thinks of occupying a station continuously for 80 to 110 days to get enough clear weather for complete observations; of needing 92 days for reconnoitering and monumenting one station; of spending 14 days hacking, wading, and climbing 20 miles airline distance to reach a station. Most of our first 2 years was devoted to organizing, negotiating, equipping, and training. We continually have, along with other operations, the important collateral mission of training additional collaborating personnel to augment the hemisphere's mapping potential.

In Central America, two local geodetic datums had been previously established: the Ocotepeque datum on the Guatemala-Honduras boundary, and the Balboa datum around the Panama Canal. Assumptions made by the U. S. Coast the Geodetic Survey were remarkably precise in setting up the Balboa datum in relationship to the Ocotepeque datum, more than a thousand miles away, as initial computations show our closures between them to be 21 feet in latitude and 269 feet in longitude.

Most of the tide gages have now operated long enough to permit the U. S. Coast and Geodetic Survey to establish a preliminary mean sea level value at each station. These values are already proving useful locally as a firm reference for local engineering and surveying work.

Last season, the U. S. Navy's hydrographic ship, the USS *Tanner*, did considerable hydrographic work off the coast of Venezuela; Navy photographic aircraft flew coastal areas in Central America and Northern South America.

We hope to see a first-order geodetic net established and interconnected throughout all of the countries of Latin America in the near future. Nearly 2,000 first-order stations will be involved in one north-south arc alone. This will permit the establishment of a South American geodetic datum which will be connected to the North American datum, thus tying together mapping control from the Bering Sea to the Straits of Magellan.

Although we have concentrated on source material and on the establishment of datums, there are now plans for expanding our program to a broader one of collaboration, training, assistance in third-order control work, local procurement of aerial photography, and map compilation. We hope soon to begin to realize the true end of the mapping endeavor—the publication of some finished maps and charts, which can be of real value to the commerce, economy, and relations of the collaborating nations.

COMPLETED AND PROJECTED FIRST ORDER
GEODETIC TRIANGULATION IN
SOUTH AMERICA
LEGEND
Completed Triangulation
Projected Triangulation
Tide Gages

OPERATIONAL DIFFICULTIES

The scarcity of experienced geodetic personnel has been a big problem, but we now have an intensive, 3-month field training program in the Republic of Panama for the training of all new employees. Our operations are expected to get a considerable "shot in the arm" as soon as the 50 civil engineering college graduates, which we are currently hiring, have completed this training.

Perhaps we all encounter too many administrative problems. One of the problems in connection with these expeditions into the hinterlands has arisen from that vagary of government administration which requires that no per diem expenses shall be paid when government quarters and rations are furnished. In our operations, the government furnishes a jungle hammock which is gingerly hung in the dripping, insect-infested jungle vegetation by a weary surveyor in order that he may rest his rain-sodden bones after gulping some Army C rations from a tin can. You should hear the screams when per diem must be deducted for that.

The growth of fungus on the optical elements of our theodolites has caused us a lot of trouble. The Wild Company has obligingly furnished us two test instruments on which special fungus-proofing modifications have been made We hope that the results of these tests will produce the specifications for a theodolite which can be used satisfactorily in the tropics.

Increasing difficulties have been encountered with reconditioned military vehicles. Consequently, we have turned largely to commercial types. We find that for the really rugged, back-country field work, the 4-wheel drive, 1-ton Dodge Power Wagon 126 is most useful, reliable, and durable.

Such operations as these are naturally fraught with unusual adventures and occasional disasters; several untimely deaths have saddened us and depleted our ranks. Some of the more serious accidents have been swamped landing craft, lightning striking mountain-top stations, and aircraft crashes. I regret that we have expended a number of the Air Force's single-engined liaison aircraft, but in a good cause and with a minimum of casualties.

There have been several instances where our men have been the first (white, Indian, or otherwise) known to have reached certain jungle mountain tops, notable among which is Cerro Tacarcuna in Eastern Panama and another, unnamed peak, near by.

In some of these virgin areas, the local "tigers" (really panthers), have never before encountered men and are consequently fearless, inquisitive, and dangerous. Wild boars have treed our men for hours and ripped up more than one camp site. In one such instance, a belt was all that was found to show for a hapless Indian. These pigs have made it difficult to hire local help in some areas.

Not only do operating conditions vary from those encountered on the Atlantic coast of Costa Rica, with 320 inches of annual rainfall, to the high deserts of Chile and Peru, where it has never been known to rain; but they range from the tropical forests to the highest Andes. The level line running up into Bolivia from the seacoast climbs from sea level to 13,000 feet in about 100 miles. One of the higher triangulation stations near Pico Boliva in Venezuela is at an altitude of about 15,000 feet.

We think we have the world's highest base line—Pachuni base in Bolivia, at an altitude of 14,000 feet, measured in 6 days.

Because of the severe seasonal operating difficulties, it was proposed that the Bolivia-Chile border enlacement be closed with one grand slam during which it was gambled that final reconnaissance and observation could be accomplished jointly. (This difficult enlacement has now been completed.) In closing the last two figures of this international tie, some doughty field engineers struggled 18,000 feet up Cerro Santiago (incidentally much higher than any mountain in the United States) after their local Indian guides and helpers quit halfway up. Imagine their disappointment when they found the proposed line of sight blocked by a little old hill of only 16,000 or 17,000 feet. We will tackle that one again next year when the snow and altoplano salt flat conditions get just right.

AIRCRAFT ASSISTANCE

Our whole program would bog down if it were not for the airplane. We use air transportation to get back and forth between the various countries involved and in close-in field operations for reconnaissance and air supply. We have recently been very fortunate in getting Air Force L-13 liaison aircraft—beautiful, light planes which can land or take off from a very small clearing of about 500 feet. I would like to commend those Air Force boys who fly us right down to the jungle top, in between rocks, and daily flirt with becoming a "statistic." There are some very good bush pilots among them.

Men who have been out on a remote station for weeks often gather in the tiny clearings to watch the air drops of supplies when the planes come over. But in one area they have been scattering and taking to the tall timber for we have been kicking out dynamite without parachutes for "free-fall" delivery.

Helicopters are of enormous value, even though one caused us some "flying saucer" trouble. In Costa Rica, for example, reaching station Matama was a 16-day pack trip by foot. It was subsequently reached in 20 minutes by a helicopter which has landed at altitudes as high as 6,200 feet. However, we cannot afford to be too streamlined. It is preferable for the personnel to walk either going in or coming out, because descriptions of routes of access to stations written by men in helicopters are a bit lacking.

Last year, Col. F. S. Tandy, our former director, told you that a helicopter had been used in Cuba with great apparent success in reconnoitering for lines of sight and tower heights by flying altimeter profiles along the lines of sight just above the tree tops and hovering over the proposed stations with a weighted steel tape. Sixty lines of sight were selected in 30 days, and this year's operations have proven them 100 percent satisfactory.

The Navy's hydrographic ships have also employed helicopters very successfully in their Venezuelan operation for ship-to-shore transport of personnel and equipment to the stations.

INTERNATIONAL SIGNIFICANCE

How does all of this technical and adventurous effort tie into the international picture? The program is the embodiment, in action, of several commendable trends in cooperation. It is a unified, inter-service activity, integrating elements of the Army, Navy, and Air Force. Within the structure of the United States Government, it is an inter-agency undertaking, involving, among others, the interests and contributions of the Departments of State, Commerce, and Interior, as well as the Department of Defense. It is international in character in that it operates under a series of bilateral agreements between the

United States and the collaborating Latin American nations, and because of the impunity with which the surveys and aerial photography cross previously formidable international boundaries.

Some of the contributions which this program can make to the Western Hemisphere are as follows:

(1) Promote development of the peacetime economy.
(2) Promote exploration for, and development of, critical and strategic raw materials.
(3) Bolster the defense of the hemisphere.
(4) Promote the adoption of standard techniques and equipment.
(5) Promote all-important hemispheric solidarity.

We have had the unique privilege of freely crossing several delicate international boundaries and tying these neighboring countries together with geodetic triangulation arcs. In one case, our survey parties actually worked right across a "no-man's land." High tribute is due the engineers who can get together on common problems.

Probably the most international operation yet undertaken was the triangulation across the Gulf of Fonseca, where the nationals of 4 different countries worked together—the hard-working engineers of El Salvador, Honduras, Nicaragua, and the United States. In the completed work in Central America alone, there have been 11 international geodetic ties, each involving close cooperation between the engineers of the countries involved.

We are now working on the difficult problem of how to handle aerial photography covering an international border.

It is sincerely hoped that this undertaking does not give rise to misgivings that it is a military endeavor. Within the structure of the Government of the United States, the allocation of the responsibility between the respective mapping agencies has been such that the Department of Defense, presumably because of its facilities and operations, has the responsibility for foreign mapping. In this program, the United States is collaborating with all types of agences, including universities, military academies, Army Engineers, Infantries, Navies, Bureaus of Public Works, Bureaus of Roads, Departments of Mines and Forestry, and Departments of Agriculture. It should be viewed as no more military in character than the river and harbor and flood control work of the U. S. Corps of Engineers.

Of course, any undertaking of this type can be evaluated in the light of its defense of strategic significance, even as our civil industrial potential; but any defense aspects are not solely those of any one nation, but rather of a unified hemisphere.

The field of raw materials is one in which the United States-Latin American interdependence in peace and in war is forcibly demonstrable. These raw materials are fed into the hungry maws of the United States' industrial machine, and come out as finished goods for the Latin American consumer in time of peace and as instruments for our common defense in time of war.

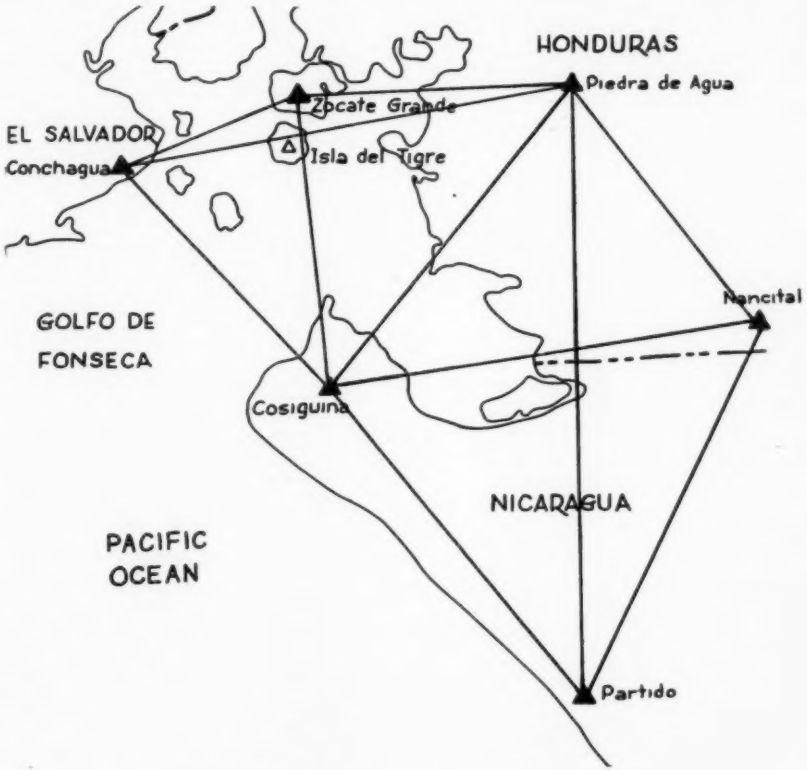
STRATEGIC RAW MATERIALS IN LATIN AMERICA

During the last war the United States was so short on critical and strategic raw materials that the Air Transport Command flew in many cargoes of minerals from overseas. You may be surprised to know that except for coal, iron, and salt, some of every war mineral was imported, including 99 percent of

the quartz crystals required for our radar equipment and radios (from Brazil), 83 percent of the antimony used (much from Mexico), 91 percent of the beryl (again mostly from Brazil), 90 percent of the chromium (much of it from Cuba), 85 percent of the manganese (mostly from Latin America), all of the industrial diamonds (many of which came from Venezuela, the Guianas, and Brazil), all of the tin (to which Bolivia contributed much), and 88 percent of the mica and 61 percent of the tungsten, also Latin American products.

The wartime figures are especially impressive, but the short supply of raw materials within the United States makes us increasingly dependent on these sources in our peacetime economy.

At the present time, the United States' supply of bauxite is nearly depleted, and our vast aluminum industry imports about 60 percent of this source mineral from Latin America. The many special steel alloys required by our modern, highspeed, jet-propelled industry require more and more of the rare minerals. There are dozens of other critical and strategic minerals in which Latin America



INTERNATIONAL TRIANGULATION NETWORK

figures heavily, not to speak of hardwoods, tropical fruit, fibres, sugar, and rubber.

In a recent year, United States oil companies spent 263 million dollars for equipment and operations in Latin America. The average South American oil well produces 164 barrels of oil a day in comparison to an average of 12 barrels in the United States. A year's Latin American production amounts to around 500 million barrels.

In Venezuela, there has recently been uncovered what has been termed the world's largest and richest iron ore deposit, in the exploration for which modern mapping methods contributed much. It is an entire mountain of ore, estimated to contain around 500 million tons analyzing 60 percent pure iron. The U. S. Steel Corporation plans to spend 400 million dollars in developing this find, which is larger and better than its Minnesota holdings ever were. The discovery is especially significant to our industry at a time when the famed Mesabi iron range is approaching exhaustion.

CONCLUSION

To you of the surveying and mapping field it is needless to explain how greatly surveying, mapping, and charting can increase efficiency and economy in the production of these raw materials, not only in current operations and vital transportation and communications, but in exploration for, and development of, many new sources, and in the closely allied and contributing hydroelectric developments, irrigation projects, land classification and resettlement, tax reforms, et cetera.

The contribution which this program can make to the Point Four Program of technical assistance should be immediately apparent to this audience which appreciates the vital role of surveys and maps in providing the planning data, the blueprint, and the tools which are such vital prerequisites to the intelligent and economical planning and operation.

It is significant and inspiring to see the common interests of neighboring sovereign nations being tied together by these surveys and technical cooperation which flit with impunity across the artificial barriers of political boundaries, leaving the selfish and trouble-making factors of sovereign polities and exploitative industry behind.

This is neither an endeavor of exploitation nor of commercial imperialism. It represents a real merger of respective national interests and programs in the promotion of hemispheric solidarity and development so that our peacetime economy may better flourish, or, that in the event of war (which we all hope will never come) we will be better prepared for defense.

It is most gratifying to see that the United Nations is moving toward encouraging regional cartographic meetings and programs of action throughout the world, patterned after the techniques and success of the Pan American Institute on Geography and History meetings and this action program of the Inter-American Geodetic Survey, and inspired by some of the same pioneers who were instrumental in establishing it. I fervently hope that this portends worthy and constructive things-to-come in the international field; that the theme and pattern for future international cooperation and solidarity in the interests of a more prosperous peacetime economy and for the elimination of war may be along these proven collaborative lines with surveying and mapping blazing the way.

Standardization of Maps

By JACOB SKOP

CHIEF, MAP DESIGN, ARMY MAP SERVICE

BOTH THE MAP MAKER AND THE MAP USER generally agree that standardization of maps is desirable. But standardization is not justified by desirability alone if it hampers either the military or civilian use of the map. It would be justified on this basis, however, if the inconveniences to the user were slight and if there were no doubt that the user could easily adjust himself to the changes.

Standardization is essential if it results in material over-all savings to the Federal Government. This fact is indisputable. And a paramount consideration is the fact that standardization is essential if its non-establishment affects national security.

The end of World War I created a mistaken idea that peace would thenceforth rule throughout the world. Our nation initially subscribed to this principle. Later, as the war clouds gathered on the horizon, we elected to shut out the disagreeable picture with a screen of isolationism.

This was reflected in our mapping. All our efforts were concentrated on making maps of the United States. And these efforts were necessarily meager, controlled by a Congress struggling to extricate the Nation from the depression. It was a sad commentary that the richest nation of the world was among those most inadequately mapped.

Under these conditions, there was little need for standardization of maps. The few quadrangles produced were largely products of one agency—the U. S. Geological Survey. Map symbols established by the Board of Surveys and Maps covered all needs. Our map makers knew our country well and few problems out of the ordinary arose insofar as interpretations of features were concerned.

The 7th of December 1941 brought Pearl Harbor and with it a revolution in mapping. A global war required a previously inconceivable number of maps of all scales and areas. To fill this need, new mapping agencies mushroomed and existing agencies were tremendously expanded. In making maps for foreign areas, many features were encountered which did not exist in the United States. Existing American symbols were adopted for these features in some cases, either as they were or somewhat modified. In other cases, new symbols were either manufactured or adopted from native maps. There was little time to maintain proper liaison between map-producing agencies. Our troops could not get maps fast enough. As a result, different symbols for the same feature appeared on maps made by different agencies and even by the same agency. Of possibly more consequence, there was a lack of consistent interpretation in dealing with mapped features during compilation.

The insistent demands for troops allowed no more than a few hours for instruction in map reading during basic training. The average soldier had little familiarity with American map symbols and no knowledge whatever of their adaptation in mapping foreign areas. On one set of maps a certain symbol might mean a *hard surface, all weather road* and on the adjacent series the same symbol might represent an *improved dirt road*. Again, on one map, a *dirt road* might

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be represented by a symbol which was totally different from the symbol used to represent the same road on maps of an adjacent series. Similar differences existed for numerous other features shown on the maps. All this was very confusing to the GI and detracted from maximum efficiency in using maps.

In the United States, the war gave a tremendous impetus to mapping. This was especially true around military posts, camps, and stations and in strategic areas. Wherever the U. S. Geological Survey and the other non-military mapping agencies—which were already overloaded with military work in addition to their own—could undertake no further commitments, the Corps of Engineers engaged in domestic mapping in areas with which national defense was concerned. While the symbols established by the Board of Surveys and Maps were followed as closely as possible, they were no longer completely adequate. Many modifications and some additions had to be made to keep step with technologic advancements and development of communications. Here again, the pressure of time unfortunately did not permit proper liaison between agencies, and as a result there was a lack of consistency in interpretation and in delineation of features.

At the termination of the war, the military authorities, realizing that it was mandatory for the three services to "speak the same map language," set up a committee called the Joint Mapping and Photographic Committee—commonly referred to as JMPC—to effect, among other things, a standardization of military map and chart symbols. A JMPC subcommittee was appointed to accomplish this particular phase of the work. Originally, the subcommittee consisted of representatives of the Aeronautical Chart Service, the Hydrographic Office, and the Army Map Service. Early in the proceedings, however, it was realized that the non-military Governmental mapping agencies were vitally concerned with large-scale maps and were equally eager to effect standardization. Furthermore, it was advantageous to make full use of the many years of mapping experience of the non-military agencies. Consequently, these agencies were invited to participate in the meetings of the subcommittee. Invaluable contributions were made by the technical representatives of the Coast and Geodetic Survey, the Forest Service, the U. S. Geological Survey, and the Tennessee Valley Authority. It is doubtful whether the complete standardization which was effected for large-scale maps could have been achieved without this personnel.

The original plan called for only the standardization of symbols. It was soon apparent, however, that this was not sufficient. It would be pointless, for example, if the subcommittee agreed upon a symbol for a *hard surface, heavy duty road* but did not agree upon just what constituted such a road. The subcommittee, consequently, expanded its scope to include interpretation of features. The resulting agreements were important since they have served as the basis for the current large-scale map specifications of each participating agency.

One of the great stumbling blocks in the proceedings was map scales. Civilian agencies published quadrangles at scales of 1:24,000, 1:31,680, and 1:62,500; whereas the military were committed to 1:25,000 and 1:50,000 scales. The subcommittee realized that standardization of quadrangle scales would not only be highly desirable but would result in considerable over-all savings to the Federal Government. However, both the civilian and military agencies felt that the scales each used were essential to the users of their products. This eliminated the possibility of standardizing the published map scales. Fortunately, however, the subcommittee compromised on a measure which did permit over-all economy.

The greatest cost in preparing a new map lies in compilation and drafting. By comparison, the cost of reproduction is negligible. Again, it was accepted that each quadrangle had to be published in both civilian and military editions. Savings would be possible if color-separation drawings were prepared in such a manner that they could be exchanged between agencies to serve with a minimum of additional work as photo copy. The subcommittee reached an agreement which satisfactorily accomplished this. Standardization of compilations and drafting scales was effected. All map symbols were to be drafted at the same weights, gages, and scales, whether published at scales of 1 : 25,000, 1 : 31,680, 1 : 50,000, or 1 : 62,500. Since civilian agencies would have no use for a military grid, it was agreed that this item would appear on a separate drawing rather than in combination with the culture as was the previous practice. This eliminated the considerable difficulty which would be encountered by the civilian agencies in eliminating unwanted grid lines. These measures made interchange of drawings possible, which in turn permitted tremendous savings to the Government. It was no longer necessary for one agency to redraft the drawings of another to obtain copy which would conform to its particular standards.

The JMPC subcommittee completed its work on large-scale maps about a year ago, after 2 long years of concerted effort. The results are well worth this effort. Large-scale map symbols and mapping practices are now standardized for U. S. mapping agencies.

The subcommittee followed a policy of incorporating the characteristics of simplicity of design and utility in the standardization of symbols. The majority of these are self-explanatory and even the beginner should be able to read a map employing them without too frequent references to a symbol book. Where an existing symbol was adequate, it was retained. Symbols were designed from the point of view of the map user not of the map maker. There was no attempt to force an entirely new language on the map reader; rather, the existing language was adapted to current problems and conditions. An improvement was the elimination of seldom-used symbols; it was agreed that a note printed on the face of the map was more feasible to explain such features.

Concurrent with the proceedings of the large-scale subcommittee, two other subcommittees were engaged in the standardization of 1 : 250,000 and 1 : 1,000,000 scale maps and charts. While this work is not yet finished, it is not far from accomplishment.

The United States was not the only country to realize that map treatments and symbolization required revision and standardization. World War II proved to the discerning mapping agencies of other countries that a review of existing practices and a drastic revision were in order.

Halfway through the JMPC proceedings, Canada, Great Britain, and the United States agreed to a plan for standardizing their arms and military training. One of the ramifications of this program was the standardization of maps and charts. Tri-country committees were set up and great progress has already been made. The United States was particularly fortunate in being able to present proposals resulting from the JMPC proceedings which reflected the united ideas of its three services.

Since the war, our Latin-American cousins have evoked a considerable interest in mapping. Practically every country has projected an ambitious mapping program which, if effected, will add considerably to the mapped areas of the world.

Technical representatives of these countries have been provided with the results of JMPC proceedings and have evidenced a noteworthy desire for standardization. The time may soon be ripe to implement official procedures to effect such standardization. In fact, at the Fourth Pan American Consultation on Cartography, held in Buenos Aires in 1948, a group of experts within the Committee on Topographic Maps and Aerophotogrammetry was assigned to make a study of existing map symbols of the pan-American nations and to present at the Fifth Consultation a Regulation on Symbols which will satisfy the needs of all member countries. The JMPC agreements and those reached between the armies of Canada, Great Britain, and the United States will undoubtedly be given serious study since they have already carried the light of standardization deep into the darkness of confusion. Similarly, technical representatives of many European mapping agencies have evidenced an interest in the standardization proceedings thus far attained.

Considering these facts, it is possible that the age-old dream of the International Mapping Conference of the World for standardization may be effected in the not distant future.

In any standardization one important thing must not be forgotten. Maps, like the features they portray, are not static; they are constantly going through an evolution. Scientific developments and changing military techniques make it compulsory that the symbolization and treatment of features agreed upon be reviewed from time to time and that appropriate changes be made. Only if this principle is followed will standardization be effective. The mold must not be hard and fast; it must be pliable.

Land Titles à la Shakespeare

EDITOR'S NOTE.—The works of William Shakespeare reveal the frequent use of legal terms, which lends support to the conjecture that he at one time served in the office of a Stratford attorney. The following poem, which first appeared in the Souvenir Booklet published by the Brazoria County Abstract Company, Angleton, Tex., on the occasion of their 75th anniversary, suggests a possible answer to those who may wonder how Will Shakespeare, barrister, would frame his notes of examination of a title. The poem illustrates how Shakespeare, after studying a voluminous abstract of title to a tract of meadowland in the County of Warwick, might have reported to his client:

Upon this faded parchment, dimn'd with age,
Some scurvy Scriv'ner hath most illy writ
The Fitful history of that fair tract
By whose lush banks sweet Avon softly flows,
Where violets rear their gentle heads at dawn,
Adrip with dew, to greet Aurora's shafts
Which pierce the misty gray that veils the East.
A lovely tract, in sooth, and yet, alas,
Its title doth most grieviously offend
And shrieks its imperfections to high heav'n.

'Tis stated here in smug and unctious words
A course "doth run some twenty rods due north."
"Doth run!" Gadzooks! could not the course but amble,
As well beseems a true and righteous course?
But must it most incontinently "run,"
Like frightened hare pursued by yelping hound,
And void its true intent by dereliction!
The thing is vile! I'll none of it, I' faith!
And here, upon this page, the smiling villain
Hath writ a damning deed whose foul intent
Doth make my blood to boil. One Roger Busby
Conveys the tract for stated sum of lucre
Without his worthy dame's consent thereto!
O horrid deed! O cruel and specious rogue
To so defraud his dame of that same dower
Assured her by the laws of this fair clime!

Methinks Dame Busby roams the barren heath
Oppressed by woe, and lifts her haggard gaze
To heaven's dome, and cries with piteous moan
"My dower!"—and then bends before the gale
And babbles of her tract of meadowland
So filched from her by act of scoundrel spouse.
O hellish blots! O foul and Tainted thing!
The title shall not pass! 'Tis shot with flaws
And honeycombed with doubt, and tinctured deep
With that fell stuff which lawyers call "defects."
No affidavit, sworn by hoary rogue,
Nor statute cited oft by quibbling knaves,
May minister to errant course, diseased,
Nor silence poor Dame Busby's cry of "Dower!"
The title must be purged and duly shriven
By just Decree of Court, and cleared of clouds
That mar its ready moving on the mart,
Ere I shall say " 'Tis well—the deed may pass."

—PHIL CARSPECKEN

* * *

GEORGE WASHINGTON SLIPPED HERE

George Washington slipped here—but not very much. This refers to his survey for the boundaries of the District of Columbia more than a century and a half ago. When the father of his country surveyed the southwest boundary of Arlington County, Va., he deviated from a true line by 1′ 14″ at one bearing point.

Authority for this is J. R. Wigglesworth, chief of the Arlington County survey department. Mr. Wigglesworth said, "Frankly, I think Washington did a wonderful job, considering what he had to work with." It seems that when he did this work in 1791 he had only a compass set on a wooden stand with peep-sights—no high-grade transits with telescopes worth $500.—*Engineering News-Record*, January 18, 1951.

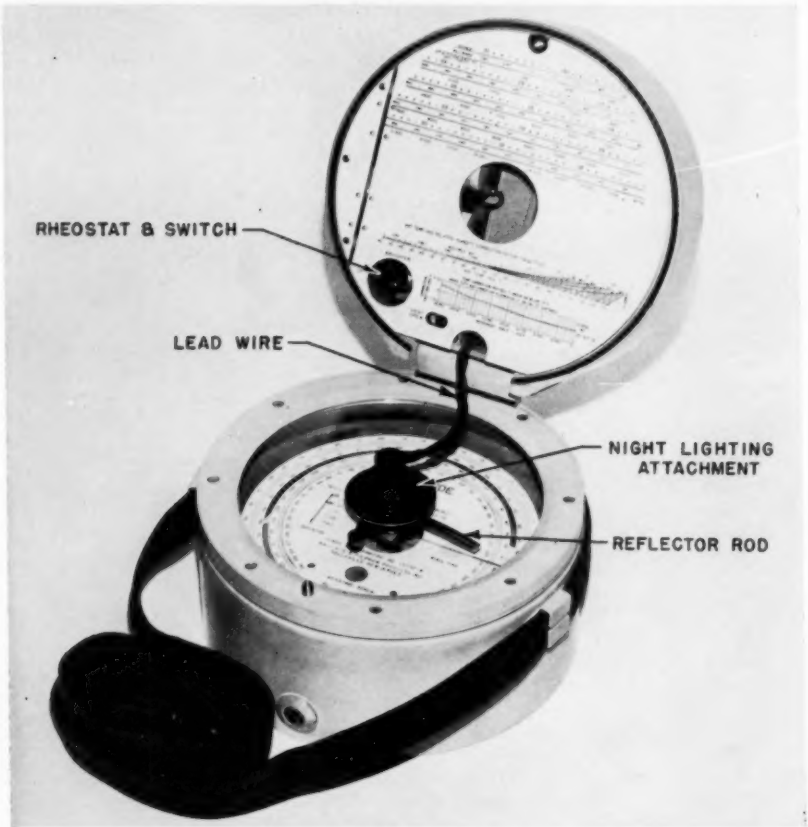
New Surveying Altimeter Announced

By OSCAR W. BOWKER

PROJECT ENGINEER, SURVEYING BRANCH, ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES, FORT BELVOIR, VA.

A SURVEYING ALTIMETER that will measure elevations with an accuracy of approximately 2 feet has been designed and tested by the Army's Engineer Research and Development Laboratories.

This instrument is an aneroid type barometric leveling device for use up to 15,000 feet above sea level. The mechanism consists basically of a single vacuum chamber, which expands and contracts in response to changes in atmospheric pressure. As the chamber fluctuates, it actuates the attached curved rack,



NEW 15,000-FOOT SURVEYING ALTIMETER

pinion gear, and shaft, which convert the movements of the chamber to rotation of the indicating hand.

The housing for the mechanism, which also serves as a carrying case, is constructed of aluminum and is equipped with a window, hinged lid, and shoulder carrying strap. Rubber shock mounts are provided inside the case to protect the mechanism from shock and vibration. The interior of the case is maintained at a low humidity by means of silica gel desiccant.

The dial for the altimeter is circular and has four scales, each of which covers approximately one-fourth of the instrument's range of 1,000 feet below to 15,000 feet above sea level. Since the indicating hand, or pointer, makes four revolutions to cover the entire range, a revolution indicator is provided so that the observer can determine upon which scale the instrument is operating.

The altimeter is also equipped with electric illumination and can be used for day or night operation. The night-lighting attachment is mounted in the center of the window of the instrument, in a rotatable socket which carries a Lucite reflector rod to direct the beam of light on the scale.

The lid contains a conversion and correction chart, a rheostat and switch, a reading glass, a sling psychrometer, a screw driver, a spanner wrench, the lighting attachment when not in use, and two batteries which furnish energy for the 1½-volt lamp that illuminates the scale.

Engineering tests performed in the vicinity of Fort Belvoir, Va., indicate that the majority of the elevations established were correct within 2 feet when proper observing techniques were employed utilizing the two-base method of altimetry.

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Texas Section Holds Spring Meeting

The regular spring meeting of the Texas Section of the American Congress on Surveying and Mapping was held in Houston, Tex., on February 22, the birthday of one of our best-known surveyors—George Washington.

Sol A. Bauer of Cleveland, Ohio, immediate past president of the ACSM, delivered the principal address. Other speakers included G. Brooks Earnest, Dean of Engineering at Fenn College, Cleveland, Ohio; Max J. Gleissner, Chief of Field Surveys of the U. S. Geological Survey, Rolla, Mo.; and Ralph S. Ellifrit, Director of City Planning of Houston, Tex.

The interest manifested in Texas on the subject of surveying and mapping is attested by the publicity given to the meeting by six newspaper articles.

Forty-nine of the sixty-five members of the Texas Section were present at the meeting. The attendance also included some ten guests. Grant W. Herzog of the Shell Oil Company, chairman of the Section, presided over the meeting.

—Forrest Daniell

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

PRECISION PLOTTING TABLE. *Engineering News Record,* June 29, 1950. (Details of a new plotting table which simplifies rapid plotting and measuring of points on plane surfaces in terms of rectangular coordinates.)

AIR SURVEY IN MALAYA. R. D. Tremaine, *New Zealand Surveyor,* August 1950. (Discussion of a method developed for mapping areas covered with heavy tropical jungle.)

LARGE AND INTERMEDIATE SCALE MAPPING OF EXTENSIVE AREAS WITH APPLICATION OF SPATIAL AERIAL TRIANGULATION. MAPPING EXAMPLE OF ISRAEL. T. Blanchut, *Photogrammetric Engineering,* September 1950.

THE APPLICATION OF RADAR TO SURVEYING. J. Warner, *Empire Survey Review,* October 1950. (Describes the application of radar to surveying for precise measurement of long lines, and its use as a navigational aid and position-fixing device for an aircraft performing photogrammetric surveys.)

PROFESSIONAL CONSCIOUSNESS. Submitted by W. Humphreys, *The Canadian Surveyor,* October 1950. (Excerpt from an address by John E. Armstrong before the Engineering Institute of Canada.)

CARTOGRAPHY ROUND TABLE. Erwin Raisz, Chairman, *The Professional Geographer,* Special Cartography Issue, November 1950. (Reports of panel discussions presented at the April 1950 Meeting of the Association of American Geographers.)

MAPS FOR KOREA. J. G. Ladd, *The Military Engineer,* November–December 1950. (Outlines the problems in providing maps in large quantities for military operations.)

GEOGRAPHY AND THE UNITED NATIONS. Jean Gottmann, *The Scottish Geographical Magazine,* December 1950. (A brief summary of the attention given to geography within the framework of the United Nations.)

THE LOUISE A. BOYD SEVEN ARCTIC EXPEDITIONS. Louise A. Boyd, *Photogrammetric Engineering,* December 1950. (An account of the author's extensive Arctic explorations since 1924.)

PHOTOGRAMMETRY LOCATES 208 MILES OF PENNSYLVANIA TURNPIKE EXTENSIONS. Frank J. Williams, *Civil Engineering,* December 1950.

PHOTOGRAPHY RELATED TO INVESTIGATION OF SHORE PROCESSES. Francis P. Shepard, *Photogrammetric Engineering,* December 1950. (Contains a number of photographic views of various shoreline types.)

MERCATOR GRID: ITS PRACTICAL AND PEDAGOGIC MERITS. Clarence L. Vinge, *The Journal of Geography.* January 1951. (Discusses the properties of the Mercator projection which make it especially desirable for classroom use.)

STATUS OF PROPOSED ENGINEERING LAW. *The Engineers' Bulletin,* January 1951. (Report on a proposed bill to regulate the practice of professional engineering and land surveying in Colorado.)

COMBINED SURVEYING OPERATIONS IN ALASKA. Robert F. A. Studds, *The Military Engineer,* January–February 1951. (Discusses the use of ship-based parties to accomplish all phases of the survey of a coastal area.)

THE EVOLUTION OF MILITARY GRIDS. Jacob Skop, *The Military Engineer,* January–February 1951.

RAMARK RADAR BEACONS. Eric J. Isbister, *The Military Engineer,* January–February 1951. (Discusses a new type of radar beacon used as an aid to marine navigation.)

BOOKS AND PAMPHLETS

AIR SURVEY. C. A. Hart. *The Royal Geographical Society,* London. 1948. 15 pages, 3 figures. 1s.

AN INTRODUCTION TO THE STUDY OF MAP PROJECTIONS. J. A. Steers. *University of London Press,* London. 1949. 299 pages. (Includes simple directions for constructing most of the common projections.)

MODERN CARTOGRAPHY—BASE MAPS FOR WORLD NEEDS. *Department of Social Affairs, United Nations,* Lake Success, N. Y. 1949. (Report by the United Nations Committee of Experts on Cartography.)

A NEW SOLUTION FOR THE THREE POINT PROBLEM. *Maryland State Roads Commission,* Baltimore. 1949. 11 pages, 4 illustrations and examples. (A practical application of the three-point fix which differs radically from that given in textbooks.)

ADVANCED SURVEYING. William Horace Rayner. *D. Van Nostrand Company, Inc.,* New York. 1950. 369 pages. $4.50. (A revised edition of a well-known text in which the fundamental principles of photogrammetry are presented.)

CIVIL ENGINEERING HANDBOOK. Leonard C. Urquhart. *McGraw-Hill Book Company, Inc.,* New York. 1950. 1,002 pages. $8.50. (Covers all aspects of civil engineering, including surveying.)

CLARION ATLAS—NORTH AMERICAN EDITION. *Longmans, Green & Co.,* Toronto, Canada. 1950. 64 pages. $1.25. (A small, general atlas of the world—page size 7½ by 9 inches—in color with relief by gradient tints. Contains special plates of population, climate, boundaries, etc.)

CONSTANTS, FORMULAE AND METHODS USED BY THE ORDNANCE SURVEY FOR COMPUTING IN THE TRANSVERSE MERCATOR PROJECTION. *His Majesty's Survey Office,* London. 1950. 32 pages. 1s. (Contains notes on the triangulation of Great Britain and on choice of projection.)

UNITED STATES ATLASES. Clara Egli LeGear. *U. S. Government Printing Office,* Washington, D. C. 1950. 445 pages. $2.25. (Contains a descriptive bibliography of 3,600 American atlases.)

USE OF STATE PLANE COORDINATES IN ROUTE SURVEYING. Hugh C. Mitchell. *U. S. Coast and Geodetic Survey,* Washington, D. C. 1950. 11 pages. (A pamphlet which provides general information on route surveying, through use of the State Plane Coordinate systems.)

GEOGRAPHY OF RUSSIA. N. T. Mirov. *John Wiley & Sons, Inc.*, New York. 1951. 334 pages. $5.00. (A first-hand account of the tectonic structure, topography, glaciation, climate, rivers, and mountains of Russia, including detailed descriptions of 20 important regions of the country.)

GEOGRAPHY OF THE PACIFIC. Edited by Otis W. Freeman. *John Wiley & Sons., Inc.*, New York. 1951. 569 pages. $6.00. (An up-to-date coverage of every important aspect of the geography of the Pacific, including economic developments, human relationships, and current problems.)

—A. A. STANLEY

DISTINCTIVE RECENT MAPS

Several maps of Latin America are featured in this quarter's selection. Especially noteworthy is the new *Geologic Map of South America*, published in 1950 by the Geological Society of America. This important compilation of geological data was prepared by George Stose.

Cooperating contributors include the American Geographical Society, the U. S. Geological Survey, and government bureaus of South American countries. Lewis B. Pusey is the geologic cartographer. The base map, on the scale 1:5,000,000, was compiled and drawn by the Heintz Company of Washington, D. C. The map is printed on two sheets, each measuring 34 by 47 inches. A separate legend sheet in Spanish and Portuguese accompanies the map. Forty-eight different formations are represented in color on the map and in the legend.

Also published by the Geological Society of America in 1950 was the *Geologic-Tectonic Map of the United States of Venezuela* (except the Territory of Amazonas and Part of the State of Bolivar). It was compiled by Walter H. Bucher of Columbia University for the Servicio Técnico de Minería y Geología, Ministerio de Fomento, United States of Venezuela. On the scale of 1:1,000,000, the map measures 32 by 58 inches. Data were supplied by the Servicio Técnico de Minería y Geología, the Caribbean Petroleum Company, the Creole Petroleum Corporation, the Mene Grande Oil Company, the North Venezuela Petroleum Company, and the Compañia Consolidada de Petróleo.

Generalized relief with hypsometric tints is featured on the *Mapa (Preliminar) de la República de Colombia*, prepared by el Instituto Geográfico Militar y Catastral. Provincial boundaries are boldly outlined. The scale is 1:2,500,000 and the measurements 30 by 22½ inches.

A new *Mapa de Costa Rica* was issued in 1949 by the Instituto Geográfico Nacional of that Central American country. On the scale of 1:400,000, the map shows railroads, several classes of roads, airports, submarine cables, lighthouses, swamps, rivers, active and inactive volcanoes, administrative boundaries, several classes of settlements, and important mines. This large colored map measures 39 by 46½ inches. Lithography is by the [U. S.] Army Map Service.

The General Drafting Company has prepared, for the Esso Standard Oil Company (Central America) S. A., road maps of five of the Central American Republics. There is no separate map for El Salvador, but most of that country is covered on the maps of Honduras and Guatemala. Each of the map sheets measures 24 by 33 inches. The scales vary. All five maps carry on their versos a large *Mapa de la América Central y Panama* and inset maps of the Canal Zone and "La Carretera Interamericana." A brief historical and descriptive summary of the country, with illustrations, is printed in Spanish on the respective map sheets. Designed for free distribution, the maps have the familiar format and cartographic qualities of domestic Esso maps.

Francis J. Marschner's map of *Major Land Uses in the United States* has long been anticipated by American geographers. It was published in 1950 by the Bureau of Agricultural Economics, U. S. Department of Agriculture. The base map, prepared by the U. S. Geological Survey, is on the Albers conical equal-area projection with standard parallels at 29° 30′ and 45° 30′. It measures 24½ by 39 inches and is on the scale of 1 : 5,000,000. Despite the small scale, the map shows considerable detail. Twelve different categories of land and land use are indicated by contrasting color symbols.

Generalized Types of Farming in the United States is another recent (1949) map publication of the U. S. Department of Agriculture, Bureau of Agricultural Economics. It is a modification of that bureau's earlier map showing *Regionalized Types of Farming in the United States.* The 1949 map "portrays the present use of agricultural resources in terms of the kinds of farm enterprises, combination of enterprises, and intensity of farming operations as measured by the amount and distribution of farm income from major sources." Color symbols differentiate nine farming types as well as "non-farming" areas. Sub-regions are indicated for each type. The map measures 29 by 36½ and is on the scale of 1 : 500,000.

Designed for classroom use is the new plastic three-dimensional relief map of the United States published in 1950 by Aero Service Corporation of Philadelphia. It is on the scale of 1 inch to 50 miles and measures 40 by 64 inches. Despite its size, it weighs only 2½ pounds and can be conveniently displayed without mounting or framing. It is printed in 11 colors on durable Vinyl plastic. Layered tints combine with the raised surface to indicate relief. The vertical exaggeration is 20 to 1. Approximately 2,000 cities, 600 rivers, 300 national parks, and 200 mountain ranges and peaks are identified on the map.

Generalized topography is shown by a combination of layered tints and shading on the *New Relief Map of the United States,* published by the Ohman Company of Memphis, Tenn. It is based upon an earlier three-dimensional relief map prepared by that company. The map, on the scale of 85 miles to an inch, is drawn on the Albers equal-area projection. It measures 22½ by 35 inches.

Essential United States Foreign Trade Routes are chartered on a map published in May 1949 by the U. S. Maritime Commission, Bureau of Government Aids. Thirty-one routes connecting U. S. ports with various parts of the world are indicated. The map is on the Mercator projection, but carries no parallel or meridian grid. It measures 16½ by 34½ inches.

Literary maps constitute one of the most popular groups of pictorial maps. Such maps, locating birthplaces and residences of authors as well as places immortalized in story or verse, have been prepared for the United States as well as for a number of the individual states. The most recent one to come to our attention is the attractive *Literary Map of North Carolina.* It was designed by Mrs. Francis Passchal (pseudonym "Primrose") and published by Raleigh-Edwards and Broughton Company. The map was prepared by the Literature Committee of the North Carolina English Teachers Association and copyrighted by the Association in 1950. It measures 20 by 33 inches. No scale is indicated.

Excellent for illustrating aspects of both physical and cultural geography is the new shaded relief map of Chattanooga, Tenn., recently issued by the U. S. Geological Survey. On the scale of 1 : 24,000, it shows most of the city's business and residential sections on the south bank of the Tennessee River. Cultural features portrayed include the railroad yards, highways and streets, public buildings and memorials, the National Cemetery,

Chickamauga and Chattanooga National Military Parks, and the highway tunnel through Stringers Ridge.

Contour lines, emphasized by artistic brown shading, strikingly portray the relief of this mountainous region. Signal Mountain, Lookout Mountain, Stringers Ridge, Missionary Ridge, and the intrenched meander and water gap of the Tennessee River stand out boldly, even to the unskilled map reader.

The Chattanooga Quadrangle was prepared in cooperation with the Tennessee Valley Authority as part of its program to present a complete series of maps covering the entire valley and surrounding areas.

Alaska is mapped on the scale of 1:1,584,000 on a new two-sheet map published during 1950 by the U. S. Geological Survey. Each sheet measures 51 by 37 inches. The map, subtitled "Alaska Map B," was "compiled from all authentic sources, chiefly maps of the Geological Survey and Army Air Forces." In addition to cities, rivers, roads, airports, and political boundaries, the map shows the several Judicial Divisions of the Territory. Glaciers are outlined, and elevations are given for a number of specific peaks.

Northwestern Canada, Transportation Facilities—1950, is the title of a map compiled, drawn, and printed at the Surveys and Mapping Branch, Canadian Department of Mines and Technical Surveys. It is on the scale of 50 miles to an inch and measures 26 by 22½ inches, exclusive of legend. Airports, landing strips, sea plane anchorages, radio ranges and stations, motor roads, winter tractor roads, and steamer routes are overprinted in red upon the official Northwestern Canada base map. A table of "distances in miles by air between main centres along principal flying routes" is given on the lower margin of the map.

Air mail routes of Europe are charted on the *Carte des Lignes Aéropostales*, published at Bern in 1950 by the Bureau Internationale de l'Union Postale Universelle. This is the twenty-third edition of the European air mail map. It measures 36 by 50 inches and is on the scale of 1:5,000,000. Internal as well as international routes are indicated.

The power transmission network of France is shown on a map entitled *Réseaux de Transport D'Énergie Électrique de France*. It was prepared by L'Électricité de France and printed, in July 1949, by Ramboult and Guiot, Paris. Existing and projected power lines of varying capacity are shown in color on a shaded relief base map prepared by *Atlas Universel* (Lib. Hachette). The map measures 32 by 38 inches and is on the scale of 1:250,000.

The distribution of *Ethnic Groups of Northern Southeast Asia* is portrayed on a map prepared by William L. Thomas, Jr., under the direction of Prof. John F. Embree of Yale University. It is designed to accompany a gazetteer entitled "Ethnic Groups of Southeast Asia," published during 1950. The base map, on the scale of 1:2,500,000, was compiled from sheets of the Army Map Service's 1:1,000,000-scale series on Asia. The map covers portions of Thailand, Burma, India, and China between approximately latitude 17° and 28° N. Four "major ethno-linguistic groups" and nineteen "minor population groups" are differentiated by contrasting color symbols. Measurements for the map are 26 by 30 inches.

—WALTER W. RISTOW

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ELEVENTH ANNUAL MEETING, JUNE 18–20, 1951, WASH., D. C.

Books in Review

GELÄNDE UND KARTE. Prof. Eduard Imhof. *Eugen Rentsch Verlag*, Erlenbach-Zürich, Switzerland. 1950. 255 pages, 34 plates. German text.

Reviewed by HELMUTH BAY, Rand McNally & Co., Washington, D. C.

PROFESSOR IMHOF'S BOOK is without exception the finest and most thorough treatise published on the art of showing the physical characteristics of the earth's surface on maps.

The first portion of the book is devoted principally to descriptions, photographs, and sketches of various land forms, and serves as a general introduction to the various techniques, described in detail further on, involved in depicting mountains on maps.

This is followed by a long chapter on map content which begins with a brief review of map projections and includes discussions of map scales, symbols, type, and perspective drawing, and also contains a brief summary of lithographic processes.

The remainder of the text, some 100 pages, is devoted to details of the cartographic techniques involved. The making of hachures, contours, color layers, form lines, shaded relief, and numerous combinations thereof, is explained at length and clearly illustrated.

The plates, in the form of an appendix, are in color and consist of examples of individual color plates as well as combinations. They show vividly what a specialized artist can do by combining shadows, shades, and tints. Of particular interest is the combination of layer tints with shaded relief and, of course, the treatment of glaciers and ice-covered terrain.

In my opinion, no cartographic or geographic library can afford to be without this work.

SURVEY COMPUTATIONS—A COMPILATION OF QUESTIONS AND SOLUTIONS. R. B. Horner. *Survey Department, Federation of Malaya.* 1948. 140 pages.

Reviewed by PROF. ARTHUR J. MCNAIR, Head of Surveying Department, Cornell University, Ithaca, N. Y.

THIS WORK consists of a compilation of 243 questions and answers taken largely from the examinations for registration of the Australian and New Zealand Survey Boards. These problems are grouped into four sections entitled: Simple road and area problems and missing data closes; Harder road and area problems and simple curve examples; Advanced computations, including three pointers, interrupted bases, and various types of curve problems; and Miscellaneous. In many problems numerical answers are not given; however, the geometric constructions are shown on the original figures and the mathematical operations are indicated.

This book may be of value to State boards of examiners for land surveyors or to teachers of surveying in suggesting surveying problems and solutions. It would also be useful for applied mathematics classes. Unfortunately for the average American, however, the units used in the book are somewhat different from standard measurements in the United States, and the relationship of the units is not shown. Furthermore, the problem statements frequently leave one in doubt as to whether the units being used are feet, chains, or rods. Some of the terminology also differs from that employed in the United States, but most surveyors will have little trouble with such terms as "road reserve."

In general, the problems presented are probably of more academic than practical interest. By making one or two additional simple measurements in the field, an alert surveyor would avoid much of the laborious computation involved in many of the prob-

lems. The problems relating to intersections of road reserves are very similar to those encountered in the western half of the United States by mineral-land surveyors in making surveys of conflicting lode claims.

UNITED STATES ATLASES—A List of the National, State, County, City, and Regional Atlases in the Library of Congress. Compiled by Clara Egli Le Gear. *U. S. Government Printing Office,* Washington, D. C. 1950. 445 pages. $2.25.

Reviewed by HELMUTH BAY, Rand McNally & Co., Washington, D. C.

THIS EXCELLENT PUBLICATION is aptly described in the preface as follows: "The geographical atlases described in this list represent a distinctive phase of American cartographic development. They are typical of American enterprise and have no counterpart in other countries, where cadastral surveys are issued by governmental organizations rather than by commercial publishers."

A large portion of the collection consists of county atlases, the publication of which began about 100 years ago. These should be of particular interest to historians and genealogists, although surveyors, geographers, geologists, and others will undoubtedly also find them useful.

General and State atlases from 1776 to the present time are also included.

The atlases are arranged by States and counties, supplemented by an author or publisher list which is keyed to a numerical system in the State list. This enables the user to find, almost instantly, all the atlases relating to a State or county, as well as to see a complete list of the atlases produced by each publisher.

It is interesting to note that one county atlas publisher produced over 500 county atlases during a period of 30 years.

The book is bound with paper covers.

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"1313 Review Questions for Surveyors"

THIS 101-page mimeographed book is a compilation of surveying questions collected at half a dozen colleges, from civil service and professional registration examinations given in six States. It is divided into 25 sections, ranging from transit, tape, and leveling work to hydrography, photogrammetry, projections, statewide coordinates, triangulation, boundary surveys, etc. Questions are of the multiple choice, completion, discussion, true and false, and problem types.

The book is obtainable for $2.00 postpaid from Prof. R. C. Brinker, Box 323, Blacksburg, Va.

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Obituary

ROBERT E. MYERS, a member of the engineering firm of Myers, Keller, and Byers of St. Louis, Mo., and an active member of the American Congress on Surveying and Mapping, died on March 23, 1951. Mr. Myers was 43 at the time of his death. Prior to his work with the St. Louis firm, he served for several years as an engineer in the Land Acquisition Section of the Maps and Surveys Division, Tennessee Valley Authority, in Chattanooga, Tenn.

Mr. Myers was active in securing new memberships for the ACSM in the St. Louis area. He was also interested in establishing junior memberships in the Congress for students at engineering colleges.

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. Authoritative articles covering this class of information are solicited. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession. —EDITOR.

Topographic Maps

THE FOLLOWING TOPOGRAPHIC maps were published between December 1, 1950, and February 28, 1951, by the U. S. Geological Survey (New Publications Lists 509 through 511). The maps are available with or without the green overprint which indicates woodland. The quadrangle name is shown in capital letters and the county name in upper- and lower-case letters. Since many quadrangle maps extend into several counties, only that county name is given which contains the place or feature for which the quadrangle is named. For example, the quadrangle COLD SPRINGS, in *Alabama*, is in parts of Cullman, Winston, and Walker counties, but only Cullman is shown because the town of Cold Springs is in that county.

Maps of areas east of the Mississippi River may be ordered from the Chief of Distribution, U. S. Geological Survey, Washington 25, D. C., and of areas west of the Mississippi River from the Distribution Section, U. S. Geological Survey, Denver Federal Center, Denver, Colo.

Alabama

CADDO
Lawrence†
COLD SPRINGS
Cullman
COURTLAND
Lawrence†
HATTON
Lawrence
HILLSBORO
Lawrence†
JASPER
Walker†
MANCHESTER
Walker
MASTERSON
Lawrence†
RIPLEY
Limestone†
SUNLIGHT
Walker
TOWN CREEK
Lawrence
TOWNLEY
Walker†

Alaska

KODIAK (B1 & B2)*
Third Judicial Division†
KODIAK (D1)*
Third Judicial Division†
KODIAK (D3)*
Third Judicial Division†
SITKA (D8)*
First Judicial Division†

Arizona

AZTEC*
Yuma
BLUE HOUSE MTN*
Gila
McFADDEN PEAK*
Gila†

California

ALPAUGH
Tulare†
AVENAL GAP
Kings
BLACK STAR CANYON
Orange
CAMP FAR WEST
Yuba
CAMPTONVILLE
Yuba
CANOAS CREEK
Fresno
CHATOM RANCH
Kings†
CHICAGO PARK
Nevada
COAL OIL CANYON
Kern†
COLFAX
Placer

* Indicates 15-minute quadrangle; all others are 7½-minute quadrangles.
† Indicates map lies wholly within county named.
‡ Indicates availability in either a contour or a shaded-relief edition.

DARK HOLE, THE
Fresno
EDISON
Kern†
FAIRFAX SCHOOL
Kern†
FAIRFIELD
Solano†
FAMOSO
Kern†
FORESTHILL
Placer
GOSFORD
Kern†
HAMLIN SCHOOL
Kern†
KETTLEMAN PLAIN
Kings†
KREYENHAGEN HILLS
Fresno†
LETHENT
Kings
ORANGE
Orange†
PAIGE
Tulare†
PENTLAND
Kern†
PIXLEY
Tulare†
PRADO DAM
Riverside
REEF RIDGE
Kings
REYNOLDS RANCH
Kern†
SAUSALITO SCHOOL
Tulare†
SMARTVILLE
Yuba
STEVENS
Kern†
STRATFORD
Kings†
STRAWBERRY VALLEY
Yuba
VIDAL*
San Bernardino†
WEST ELK HILLS
Kern†
WEST OF GOOSE LAKE
Kern†
WEST OF LETHENT
Fresno†
WEST OF TEJON HILLS
Kern†
YORBA LINDA
Orange

Colorado

BLACK CANYON OF THE GUNNISON‡
Montrose†
COLORADO SPRINGS*
El Paso
FALCON*
El Paso†
FOUNTAIN*
El Paso
GOWANDA
Weld†
GREELEY
Weld†
JOHNSTOWN
Weld
KLUG RANCH
Weld†
LA SALLE
Weld†
MILTON RESERVOIR
Weld†
MOUNT BIG CHIEF*
Teller
PROSPECT VALLEY
Weld
VALLEY VIEW SCHOOL
Weld†
WINDSOR
Weld

Colorado-Utah

DINOSAUR NATIONAL MONUMENT*
Moffat

Connecticut

NEW MILFORD
Litchfield

Florida

FORT PIERCE
St. Lucie†
FORT PIERCE NW
St. Lucie†
HINSONS CROSS ROADS
Washington
MIAMI
Dade†
MILLERS FERRY
Washington
OSLO
Indian River
VERO BEACH
Indian River†

Florida-Alabama

CRESTVIEW*
Okaloosa
HOBBS CROSS ROADS
Holmes
IZAGORA
Holmes
LAUREL HILL*
Okaloosa

Idaho

LOWER VALLEY
Caribou†
REXBURG
Madison†
RIRIE
Jefferson
ROBERTS
Jefferson
TUTTLE
Gooding
UPPER VALLEY
Caribou†

Illinois

COLUMBIA
Monroe
EDWARDSVILLE
Madison†
PEORIA EAST
Peoria
PEORIA WEST
Peoria

Illinois-Missouri

WOOD RIVER
Madison

Indiana

ARNEY
Owen
BLOOMFIELD
Greene†
HURON
Lawrence
ONWARD
Cass

Iowa

PERRY*
Dallas

Kansas

BIRD CITY NORTH*
Cheyenne†
JUNCTION CITY
Geary
KEATS
Riley†
MANHATTAN
Riley
ST. FRANCIS*
Cheyenne†

Kansas-Missouri

LEAVENWORTH
Leavenworth
OAK MILLS
Atchison
WOLCOTT
Wyandotte

Louisiana

GIBSLAND*
Bienville

Maine

CROSS ISLAND
Washington†
MOOSE RIVER
Washington†
ROQUE BLUFFS
Washington†
WHITNEYVILLE
Washington†

Maryland

CLARKSVILLE
Howard
EDGEWOOD
Harford†
GAITHERSBURG
Montgomery†
LAUREL
Prince Georges
RELAY
Baltimore
SANDY SPRING
Montgomery
SAVAGE
Howard
WHITE MARSH
Baltimore

Maryland-West Virginia

GORMAN
Garrett†

Michigan

LEWISTON*
Montmoreney
ROCKLAND*
Ontonagon†

Minnesota-Wisconsin

RUSH CITY* (Minnesota portion not mapped)
Chisago

Missouri

CAMDEN POINT
Platte†
DEARBORN
Platte
DE KALB
Buchanan
EDGERTON
Platte
GOWER
Clinton
MONTICELLO
Lewis†
POLK
Polk†
SMITHVILLE
Clay
TRACY
Platte†

Missouri-Kansas

LEAVENWORTH*
Leavenworth
NORTH KANSAS CITY
Clay
PARKVILLE
Platte
RUSHVILLE
Buchanan
WESTON
Platte

Montana

GREAT FALLS*
Cascade

Nebraska

CARNS
Keya Paha†
CODY LAKE*
Logan
DUNNING*
Blaine†
FLATS*
McPherson
JAMISON SW
Keya Paha
MARIAVILLE
Rock
MULLEN*
Hooker
PURDUM*
Blaine
RACKETT*
Garden
RIVERVIEW*
Keya Paha
TRYON*
McPherson
WRIGHT VALLEY*
McPherson

Nevada

GARDEN VALLEY*
Eureka†
ROBERTS CREEK MTN*
Eureka†
TREASURE HILL*
White Pine†

Nevada-Utah

GARRISON*
Millard

New Jersey

SALEM
Salem†

New Mexico

BITTER LAKE
Chaves†
BOTTOMLESS LAKES
Chaves†
CIRCLE MESA
Grant†
CORN RANCH
Chaves†

New York

AKRON
Erie
CORFU
Genesee
GREENE
Chenango
KENDALL
Orleans†
KENT
Orleans†
KNOWLESVILLE
Orleans
LYNDONVILLE
Orleans
MEDINA
Orleans

North Carolina

ATLANTIC
Carteret†
CLIFDALE*
Cumberland
DAVIS
Carteret†
MERRIMON
Carteret
NORTH BAY
Carteret†
SOUTH RIVER
Carteret†
WAINWRIGHT ISLAND
Carteret†

North Dakota

BURLINGTON*
Ward
GRANO*
Renville†
KENMARE*
Ward
KRAMER
Bottineau
KUROKI
Bottineau†
MANDAN
Morton

MOUSE RIVER PARK*
Renville†
SAWYER SW
Ward†
TOLLEY*
Renville
UPHAM
McHenry†
UPHAM SE
McHenry†
VELVA*
McHenry
WESTHOPE SE
Bottineau†

Oregon

DUTCHMAN BUTTE*‡
Douglas

Pennsylvania

PITTSBURGH EAST
Allegheny†

South Dakota

HIGHMORE NE
Hyde
MITCHELL LAKE
Hyde†
REE HEIGHTS NE
Hand†
REE HEIGHTS NW
Hand†
VAYLAND SE
Hand†
VAYLAND SW
Hand†
WESSINGTON
Beadle
WESSINGTON NE
Beadle†
WESSINGTON SE
Beadle†
WESSINGTON SW
Beadle

Tennessee

APPLETON
Lawrence
ASPEN HILL
Giles†
BODENHAM
Giles
WALTERHILL
Rutherford†

Texas

DUNN
Scurry
HITCHCOCK
Galveston
WELLS
Angelina
WELLS SW
Trinity

Utah

SPANISH FORK PEAK
Utah†

Vermont

BRIDPORT
Addison†

Virginia

BLACKSTONE
Nottoway
DARVILLS
Dinwiddie†
HEBRON
Dinwiddie
WELLVILLE
Nottoway†

Virginia-Maryland

MOUNT VERNON
Fairfax

Washington

DEER PARK*
Spokane†

Washington-Idaho

GREEN ACRES*
Spokane

Wyoming

BROOKHURST
Natrona†

In addition to the standard series of quadrangle maps, reconnaissance maps at the scale of 1:250,000 are being published for both the continental United States and Alaska. Maps in this series published in the period include:

Alaska

ICY BAY
Third Judicial Division†
KENAI‡
Third Judicial Division†
MEDFRA‡
Fourth Judicial Division†
MOUNT HAYES‡
Fourth Judicial Division
NABESNA‡
Third Judicial Division
RUSSIAN MISSION
Fourth Judicial Division
SLEETMUTE‡
Fourth Judicial Division†
TANACROSS‡
Fourth Judicial Division†

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UNDERWATER MOVIE CAMERA HAS NO CABLES TO SURFACE

A new underwater motion picture camera, which differs from earlier models in that it is completely self-contained, was recently developed by the U. S. Navy. Camera and diver require no air supply or electric cable connections to the surface. The camera can be completely operated from the outside, with external controls for the lens, diaphragm, focus, and start-stop switch. It has detachable wings and vertical rudder, which aid in transporting and stabilizing the equipment in the water. The camera weighs 107 pounds in air, but can be adjusted to have a positive, negative, or neutral buoyancy under water.

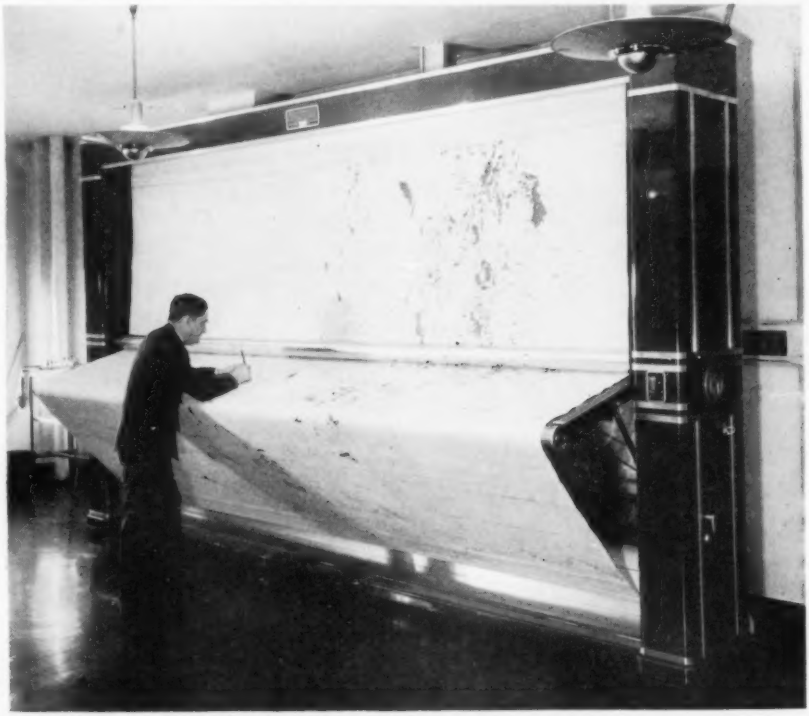
Uses of the camera range from photographing ship hulls to recording the geological formation of the sea bottom. It can also be used to photograph both marine life and plants.—*Science News Letter,* November 4, 1950.

A New Method of Presenting Maps

By LEONARD S. WILSON

ONE of the wartime duties of the Map Information Section, OSS, was the procurement, preparation, and presentation of maps required for the planning and waging of orthodox and unorthodox naval, ground, and aerial warfare. The time allowed for all this could not be counted on, for the planning meetings were likely to take place on a moment's notice.

In the course of the war, some ten thousand maps were constructed and more than two and a half million were procured by purchase, exchange, capture, and



THE McCAULEY MAP CASE SHOWING THE DRAFTING TABLE IN USE

clandestine operations. All sheets had to be examined for usability and accuracy before use. Selected cartographic documents had to be assembled in usable form, and the range of scales—from 1 : 25,000 to 1 : 20,000,000—precluded the hasty preparation of materials for display.

Attempts were made to fill the requests for map information by the use of assorted wall maps. It was found, however, that the desired information was

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seldom given on such maps. Nor were the most widely used commercial planning maps helpful. The range of subjects and the varying degree of essential detail could be obtained only from special intelligence maps and large-scale topographic coverage.

The answer to the problem was the McCauley Map Case, manufactured by Motors Metal Manufacturing Company of Detroit, Mich. The case accommodates a map coverage of 3,500 square feet. It is electrically operated, and at the press of a button it will display any area measuring not more than 11 by 14 feet.

The cabinet has storage facilities for a strip of sailcloth 14 by 250 feet. On this surface, all kinds of maps, from small-page-size world maps to wall maps and large sections of topographic maps, were mounted before the strip was installed in the cabinet. The cloth was divided into segments of various sizes, controlled by the size of the map or maps to be displayed as a unit. These pieces of cloth are furnished with zippers and can thus be exchanged in a relatively short time. Such a procedure permitted the preparation of general coverage of operational theaters before the time of need; on a few minutes' notice, the cabinet could be prepared for discussions dealing with any geographical, economic, political, or military subject.

To operate the cabinet, the user merely presses a button, and the maps pass through the viewing area at a period of 100 feet a minute. The machine is furnished with fluorescent lighting over the entire viewing area and is also made with an electrically activated table which can be raised or lowered to any desired position by the pressing of a button.

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Mississippi River Maps

A BOUND FOLIO of flood control and navigation maps of the Mississippi River, from the mouth of the Ohio River at Cairo, Ill., to the Gulf of Mexico, has been issued by the Mississippi River Commission as the 18th edition of this series. The folio was prepared from the latest available information and river surveys of the Mississippi River Commission, C.E., and the District Corps of Engineers offices, and other Federal agencies involved. The detailed maps are at 1:62,500 scale (about 1 inch to a mile) and show various types of information, such as early meander lines; levee mile posts; 5-mile river distances; locations of channel lines (without soundings); locations of navigation lights; and 5-foot contour intervals with elevations referred to Mean Gulf Level at Biloxi, Miss. The maps cover distances varying from 1 to 8 miles on either side of the river.

The folio is republished annually, the current edition (1950) superseding editions subsequent to the 1933 edition, which are out of print. The new process of printing this folio has resulted in clearer, more distinct, detailed maps with greater definition in objects depicted thereon.

The maps were prepared for general navigation use and are 13 inches wide by 20 inches long. The maps and supplementary sheets are black line photo-offset reproductions. The set is priced at $2.00 (individual sheets are not available for sale) and may be obtained by money order or certified check from the Mississippi River Commission, Corps of Engineers, U. S. Army, P. O. Box 80, Vicksburg, Miss.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the Congress. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way.

—EDITOR

"THE NEED FOR COLLEGE TRAINING IN GEODETIC SURVEYING"

MILTON O. SCHMIDT.*—However commendable the objectives of Mr. Emery's article [October–December 1950 issue of SURVEYING AND MAPPING], I find that a careful reading reveals points of confused interpretation and recommendations of dubious value. Particularly open to evaluation is the suggested presentation of a series of courses leading to a degree in geodetic engineering.

I like to be identified as a member of that group of professors in our American engineering colleges which is continually trying to advance the progress of teaching in this specialized area of civil engineering, but I cannot subscribe to the philosophies enunciated by the author. It is my belief that unless a sagacious path is chosen, a continuation of the present apathetic and puerile attitude towards this subject will be fostered.

The limited strength and adequacy of undergraduate instruction in surveying in the United States provides a good measure for appraising the stature of those engaged in this phase of engineering instruction. There are few, if any, giants among the surveying teaching profession, and the trend of events is hardly calculated to develop any. We need to mend our decrepit pedagogy and to substitute for the pedant one who is vibrant with enthusiasm and who is cognizant of the very real differences between the problems of the academic world and those of practice. The surveying divisions of our civil engineering departments have not attracted their share of those graduate engineers who have leavened their fund of knowledge with the maturity that comes only from contact with a turbulent world. The writer wishes to call increased attention to these matters, for training opportunities in geodetic engineering reflect more the persuasive efforts of the members of the teaching profession than the needs of the prospective employer or other groups.

The author has attributed to the word "geodetic" a rather broad connotation. Although in Europe the usage of this word may imply a number of well-established meanings, in this country it is subject to a specific definition. The layout and development of new towns and cities does not ". . . point to the need for a new type of professional engineer not now being trained by our colleges and universities—the geodetic engineer." This is not to question the contribution of the geodetic engineer, the mapper, and the cartographer. However, they play adjunct rather than primary roles in city planning. The dynamic impact of social and technological progress in relation to industrial and residential ex-

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pansion requires the best efforts of many engineers. The geodetic engineer in America does nothing more than secure the data upon which good mapping and planning ultimately depend. He can no more be charged with the responsibilities of orderly and systematic municipal government, with which he has no acquaintance, than the mayor of some city can be with the intricacies of higher-order control surveys.

The indiscriminate use of the terms "geodesy" and "geodetic engineering is unwise. Geodesy is the more comprehensive word, dealing not only with studies of the figure of the earth, but also with the data made available by geodetic engineering, which is fundamentally related to the measurement of angular and linear quantities on the spheroid.

I cannot share the lofty optimism that "there will be a constant and increasing demand for the services of geodetic engineers . . . in state planning commissions, highway departments, county assessors' offices, and in private land surveying organizations." This is a chimera. Even the annual requirements in peacetime of our Federal surveying agencies are quite moderate and stable. Occasional expansions are usually followed by retrenchments in personnel during the inevitable economy movements. The military implications, however, of geodesy and geodetic engineering are very real and pose problems of immediate and great importance. This the author has not mentioned.

Finally, temperate analysis of engineering college curricula leads me to feel that an undergraduate program leading to a degree in geodetic engineering would be unwise, for contemporary engineering education is predicated more upon the need to develop an inquiring attitude and a resilient mind than to accumulate many facts which the student will ultimately forget. On the other hand, the establishment of graduate programs in geodetic engineering at those few institutions which can support such an enterprise would do much to enrich and elevate academic training in this important science.

Superior instruction at the graduate level for 1 year in geodetic engineering, plus collateral work in related areas, offers, in my opinion, the soundest basis for enhancing intrinsic interest in this subject. Such training would make available a small body of well-informed students whose later professional attainments would make them geodetic engineers in the most respectful and correct sense.

FROM A NEW MEMBER

As a division civil engineer for one of the largest oil corporations in the West, I have had considerable experience in surveying, and especially enjoyed the article in your last issue by Mr. Riley, "Is Today's Surveyor Archaic?" Definitely he is! Congratulations to you and Mr. Riley—I feel very strongly on this subject myself, and would like to write something along this line for your publication sometime, if I may have that privilege.

It is a pleasure to note that you have as your chairman on property surveys, William C. Wattles. He is undoubtedly one of the leading authorities on this subject. Why not get Mr. Wattles to write a series of *practical* articles on judicial decisions surveyors must make in setting property corners? His experience is priceless, for such knowledge can only be obtained by years spent with titles and court decisions.

The knowledge acquired by Mr. Wattles, through many years of actual

"doing" in the engineering field, should by all means be recorded in books for posterity. No school can teach such knowledge—unless the teacher himself is a "doer"—and where can he find the time to gain this experience? The judgment of such men, founded upon years of direct contact with difficult problems and legal decisions, is most valuable for all engineers.

Thank you for what you are doing in editing the journal and I hope that it becomes a monthly instead of a quarterly—there is a dearth of such information as it imparts, and surveyors have been "dead on their feet" technically for too many years!—Wm. M. Bower, Los Angeles, Calif.

FROM A CONTEMPORARY

Judging from recent copies of the American "Journal" Surveying and Mapping and the wide range of professional interests covered by expert treatment therein, the American Congress is extremely active and right up to the minute with recent scientific advances, and nothing but good can come of professional association with such a live body.—*New Zealand Surveyor.*

We Salute You Mr. Marsden!

The following letter speaks for itself on the results accomplished. It was received by C. S. Maltby, Chairman, Division on Topography. Mr. Lloyd E. Marsden, Topographic Engineer for the U. S. Geological Survey, secured these applications in less than 2 weeks.

"Here are 56 applications for membership in the American Congress on Surveying and Mapping, about 50 of which show preference for the Division on Topography.

"I am circulating the field personnel as soon as additional application blanks are received from Captain Borden. I should receive approximately 30 more applications for membership.

"I am making this canvass, first, because I believe in the Congress and, second, to show my appreciation for the opportunity to attend the June Congress meeting."

Plotting Hurricanes by Radar

A discussion of "Plotting Hurricanes by Radar" was presented by Prof. Fred D. Pumphries of the Engineering Department at the University of Florida before a recent meeting of the Georgia Engineering Society. The lecture included the showing of a film which depicts the gradual development of radar research and plotting of destructive hurricanes and shows a concentric radarscope with its distance circles indicating the relative movement of a storm which recently swept over the State of Florida.

Hurricanes show up clearly on radarscope principally because the electric radar impulses, transmitted at the speed of light, are reflected back to the radar station from raindrops, which permits the plotting of the hurricanes from directions and distances obtained from the radarscope.—*The Georgia Engineer,* March 1951.

CONGRESS NEWS

Texas Section Organized

It is with pleasure that we announce the formation of a Texas Section of the American Congress on Surveying and Mapping. The first meeting was held in Houston, Tex., last October, with Lester C. Higbee of Troy, N. Y., presiding as interim chairman.

Pending the drafting of a set of bylaws and the formal grant of a charter, the following officers were elected to serve for 1 year, or thereafter until a meeting for the election of new officers is held:

Officers

G. W. Herzog, *Chairman*
O. E. Young, *First Vice Chairman*
Phil Wilkinson, *Second Vice Chairman*
Roy R. Striekert, *Third Vice Chairman*
Dick Berry, *Secretary*
Forrest Daniell, *Treasurer*

Directors

J. Stuart Boyles
E. D. Morse
S. W. Oberg
Jeff Stramler
R. A. Washburn

OFFICERS OF TEXAS LOCAL SECTION

From left to right—Roy R. Striekert, Dick Berry, Forrest Daniell, G. W. Herzog, Phil Wilkinson, E. D. Morse, and O. E. Young.

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Teaching of Cartography in the United States and Canada

(Condensed from *The Professional Geographer*, November 1950)

APPROXIMATELY 70 colleges in the United States and Canada offer one or more courses in cartography, according to a recent survey conducted by Dr. Erwin Raisz of Harvard University and reported by Dr. George Kish of the University of Michigan. Of these institutions, 14 provided 3 or more courses during the academic year 1950–51, and 7 offered advanced degrees in the field of cartography.

These statistics are based on replies to a questionnaire circulated by Dr. Raisz, received from 94 colleges and universities in the United States and Canada and from 2 institutions abroad, Oxford University and the University of Sidney, Australia. In evaluating the replies, each independent course in cartography, offered at least once every 2 years, was counted as one unit. Since courses in aerial surveying, air photo interpretation, and general surveying are offered outside the geography departments of most institutions, these subjects were not included in the survey.

During the academic year 1950–51, seven courses in cartography were offered at the University of Chicago; six courses each at Syracuse, Northwestern, and McMaster Universities and the University of Maryland; five courses at Michigan State College and the Universities of Georgia and Wisconsin; four at Pennsylvania State College and the University of California at Berkeley; and three at Oregon State College and the Universities of Kansas, Michigan, and Washington. Conversely, about 50 percent of the schools polled give a single one-semester course of a basic nature with a varying number of hours devoted to lectures and laboratory work. Twenty-five of the responding colleges at present offer no courses in cartography, although several deal with the subject as part of their regular courses in geography.

Graduate work in cartography is offered at the following institutions: The University of California at Los Angeles, the University of Chicago, The Johns Hopkins University, Kent State University, Northwestern University, Pennsylvania State College, and the University of Wisconsin.

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Contour Bottom Scanner

A NEW ELECTRONIC DEVICE for shipboard use which is expected to prove of considerable value for underwater exploration as well as for navigation in narrow channels and shallow waters has been developed for the U. S. Navy by the Edo Corporation, College Point, Long Island, N. Y.

The device is known as the Contour Bottom Scanner, or more familiarly as the CBS. Using the principle of Sonar linked to a cathode ray tube, the CBS gives observers aboard ship a detailed picture of the shape of the bottom of a harbor or even the ocean down to a depth of several hundred feet. A sunken boat, plane wreckage, or even objects as small as a human body, are clearly seen on the screen of this new electronic device. It is expected to aid materially in hunting for sunken objects as well as serve as an invaluable navigational aid in shallow waters.—*The Nautical Gazette*, April 1950.

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Graphic Time Table of the Heavens

For the 15th consecutive year, the Maryland Academy of Sciences has issued its "Graphic Time Table of the Heavens," and work is now in progress on the 1952 edition. This publication presents in graphic form an elementary almanac of astronomical phenomena, including times of sunrise and sunset, beginning and ending of twilight, and rising and setting of the visible planets (computed for latitude 40° and longitude 90°). It also contains equations of time, time of transit of the principal telescopic objects ordinarily shown to visitors at an observatory, eclipses and occultations of the brightest stars, sidereal time at midnight, and other information, all on a single 11- by 17-inch sheet. On the reverse side is a digest of the principal planetary configurations. Contact prints of the original tracing, 26 by 40 inches in size, are also available for classroom use.

The forthcoming issue of this chart will be even more useful than previous editions to engineers as well as to astronomers, teachers, and students. For the engineer the times of upper and lower culmination of Polaris will be included. A convenient scale will also be included by which star observers may plot the rising and setting of any star having known right ascension and declination.

Orders for the current issue, as well as advance orders for the 1952 edition, may be placed with Paul S. Watson, Curator of Astronomy, Maryland Academy of Sciences, 402 Cathdral St., Baltimore 1, Md. A charge of 10 cents per copy will be made to partially cover the cost of publication.

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